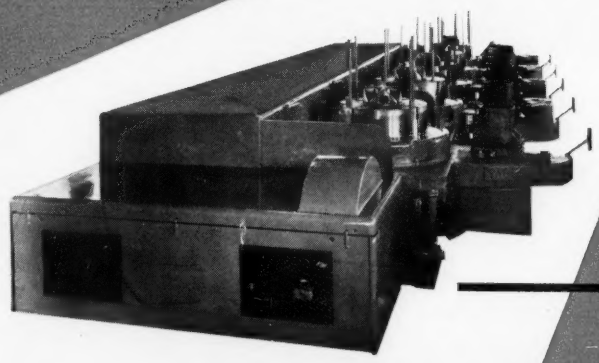
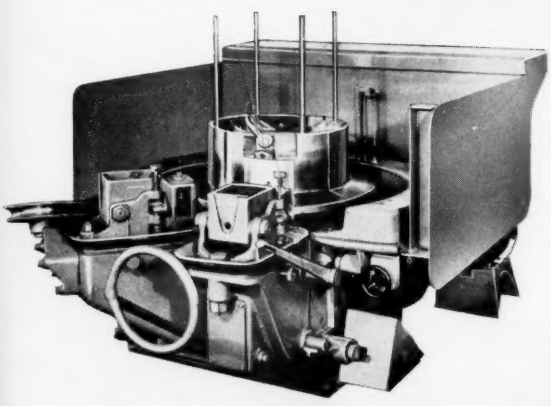
WIRE AND WIRE PRODUCTS

JULY 1948



Motoblox



Motobloc

Beat HIGH COSTS to the draw with Vaughn

WIRE DRAWING MACHINERY

Productivity . . . better, faster, more versatile . . . is Vaughn Machinery's great contribution to lower wire drawing costs. Let us show you how Vaughn productivity can serve economy in your operations.

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"Quick on the Draw!"
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Wire mills since 1871

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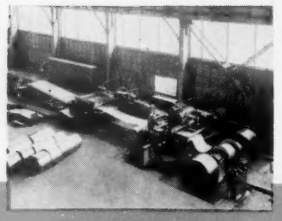
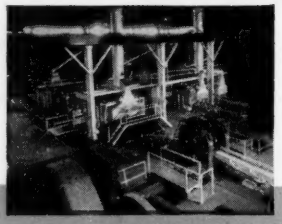
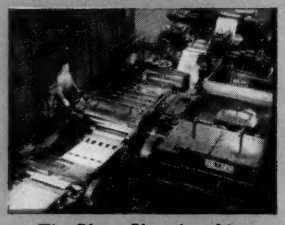


Side Trimming and Shearing Line

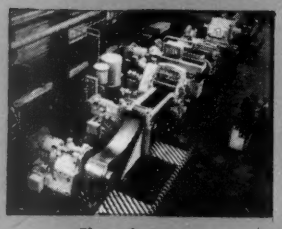


Mechanized Sheet Mill

Continuous Strip Pickling Lines

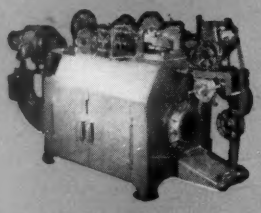


Tin Plate Shearing Line

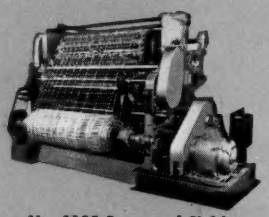


Electrolytic Line

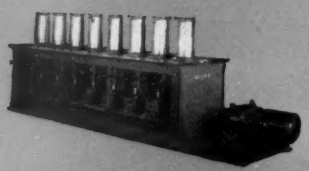
Backed Up Leveller For Wide Sheets



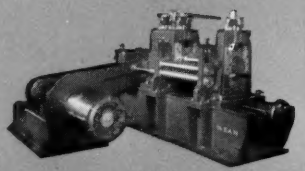
Barbed-Wire Machine



No. 1155 Farm and Field Fence Machine

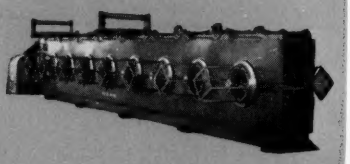


8 Block Fine Wire Tinning Take-up Frame



Strip Reel and Slitting Unit

HOLMQUIST BARBED WIRE AND WIRE FENCE MACHINERY



16 Block Wire Galvanizing Take-up Frame

Springs for Driving Comfort

Comfort is something every driver wants, whether it's a truck, bus, or the family car. And in automotive vehicle seats, as in bedding and upholstered furniture, the steel coils that provide the comfort are often made from Silver Star Spring Wire.

Silver Star is a special-analysis upholstery wire. Leading upholstery spring manufacturers depend on it for uniformity in temper, gauge, and physical properties. It's adaptable to virtually all upholstery spring designs, especially where quality and lasting comfort are foremost. The nearest Bethlehem sales office will gladly give you full details—or write us direct.

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BETHLEHEM STEEL

Silver Star SPRING WIRE BETHLEHEM STEEL COMPANY

Which of these Characteristics do you Require?

These are but a few of the many Wissco steel specialty wires produced by Wickwire Spencer, whose ability to meet exacting specifications has been a tradition for over 125 years.

We can meet your requirements for high or low carbon steel specialty wire; round or shaped; in a wide variety of sizes, tempers, grades and finishes. Send your order or inquiry to Wickwire Spencer.

IN THESE WISSCO WIRES *Strength and Flexibility* ARE ESSENTIAL

WISSCO HOSE REINFORCING WIRE, Wissco Shaft Wire and Wissco Crimped Brush Wire, while differing in chemical and physical composition, are all high in tensile strength and are manufactured for specific applications.

THESE WISSCO WIRES ARE DESIGNED FOR *Severe Forming Operations*

WISSCO BINDING WIRE and Wissco Preformed Staple Wire must be of close tolerance and uniformity as to tensile strength, hardness, size and finish.

HERE'S A WISSCO WIRE IN WHICH *Workability* IS AN IMPORTANT FACTOR

WISSCO SPHEROIDIZED WIRE is dead soft and easy on your wire working machines. After fabrication it is of a suitable type of material for hardening.

IN THESE WISSCO WIRES *Precision* IS OF VITAL IMPORTANCE

WISSCO DENT SPACER WIRE and Wissco Card Wire are held to tolerances as close as one ten-thousandth of an inch . . . must also be uniform in temper and finish and, in case of card wire, must be very straight and uniformly tempered.

WISSCO *Wire*

A PRODUCT OF WICKWIRE SPENCER STEEL DIVISION · THE COLORADO FUEL AND IRON CORPORATION

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PACIFIC COAST SUBSIDIARY—THE CALIFORNIA WIRE CLOTH CORP., OAKLAND 6, CAL.

CF&I

WIRE & WIRE PRODUCTS, Vol. 23 No. 7, July, 1948. Publication Office, at 61 Cliff Street, New York 7, N. Y. Executive Office, 300 Main Street, Stamford, Conn. Published monthly by the Quinn-Brown Corp., Richard E. Brown, President; R. S. Spengel, Secy. and Treas. Subscription price: U. S., $5.00; Canada, $5.00 per year; 50 cents per copy; Foreign, $7.50 per year. Entered as second class matter, June 14, 1946 at the Post Office. New York, N. Y., under Act of March 3, 1879.

what the WELL-DRESSED WIRE *will wear!*

THERE'S a new look for wiring, too . . . jackets made from Marvinol,® the better vinyl resin. Look at these advantages Marvinol offers!

MORE STABILITY!

Marvinol offers superior stability in processing and in end products. High molecular weight gives extra toughness . . . yet it is easy to extrude, injection mold or formulate by other processes. Wire covering made from Marvinol has greater resistance to heat and light, greater low temperature flexibility, may be brilliantly or delicately colored.

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Now available in production quantities, Marvinol resins are a development of Martin research and Martin's quarter-century of plastics experience. They're being produced in the world's most modern chemical plant to assure you of unexcelled uniformity. The Glenn L. Martin Company, maker of Marvinol, does not compound or fabricate in the plastics field. If you make, coat, buy or use wire, our expert sales engineers and fully equipped customer service laboratory offer full technical cooperation. Write: Chemicals Division, The Glenn L. Martin Company, Baltimore 3, Md.

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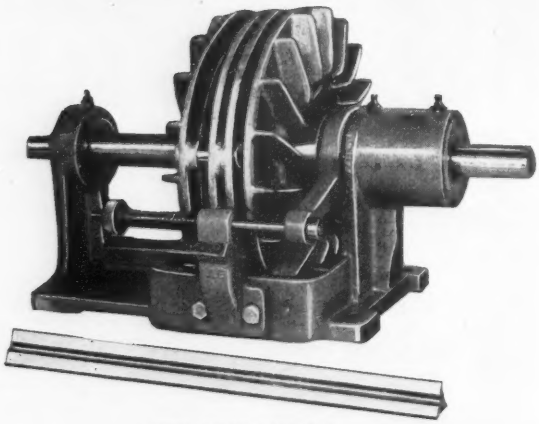
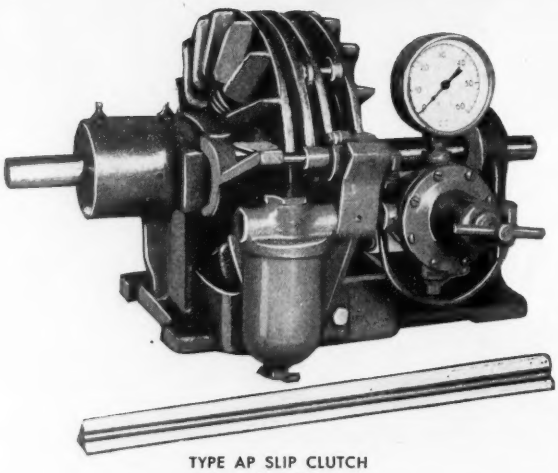
RESINS, PLASTICIZERS AND STABILIZERS, PRODUCED BY THE CHEMICALS DIVISION OF
THE GLENN L. MARTIN COMPANY • AN INTERNATIONAL INSTITUTION
"BETTER PRODUCTS, GREATER PROGRESS, ARE MADE BY MARTIN"

JLE CLASS A SLIP CLUTCH



TYPE AM SLIP CLUTCH
Screw and Spring Adjustment
of Torque Output



TYPE AP SLIP CLUTCH
Pneumatic Adjustment
of Torque Output

A Complete, Compact, "ONE PACKAGE" Clutch

FOR EASY ADAPTATION TO A SLIP-DRIVE APPLICATION, SUCH AS TAKING-UP FROM A CAPSTAN MACHINE...

Can be arranged for drives up to 3 HP. Has simplified and dependable control of torque output, mechanically or pneumatically. Can be easily adapted to constant-wire-tension reeling. Outer surfaces of friction plates are finned in Fan-Blade arrangement to quickly dissipate heat.

. . . But Best Of All It Assures

TROUBLE-FREE OPERATION!

A series of large friction discs of special composition, allows low unit pressure and minimizes wear. Anti-friction bearings are used throughout.

Get Complete Information and Quotation.

JAMES L. ENTWISTLE CO.
43 CHURCH STREET, PAWTUCKET, RHODE ISLAND
World's Leading Manufacturer of Spark-Testing Equipment
30 YEARS OF SERVICE TO THE WIRE INDUSTRY

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GENERAL ENGINEERING CO., LTD.,
BURY ROAD, RADCLIFFE,
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A Revolutionary New Compound for Wet Wire Drawing

EBONY

PROVED BY TEST TO BE FAR SUPERIOR TO ANY WET WIRE COMPOUND ON THE MARKET

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  It provides for the elimination of the difficult-to-handle petroleum oil solutions in drawing aluminum wire.
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Wire Drawing Lubricants *for Better Wire Drawing*

Standard Industrial Compounds Co.

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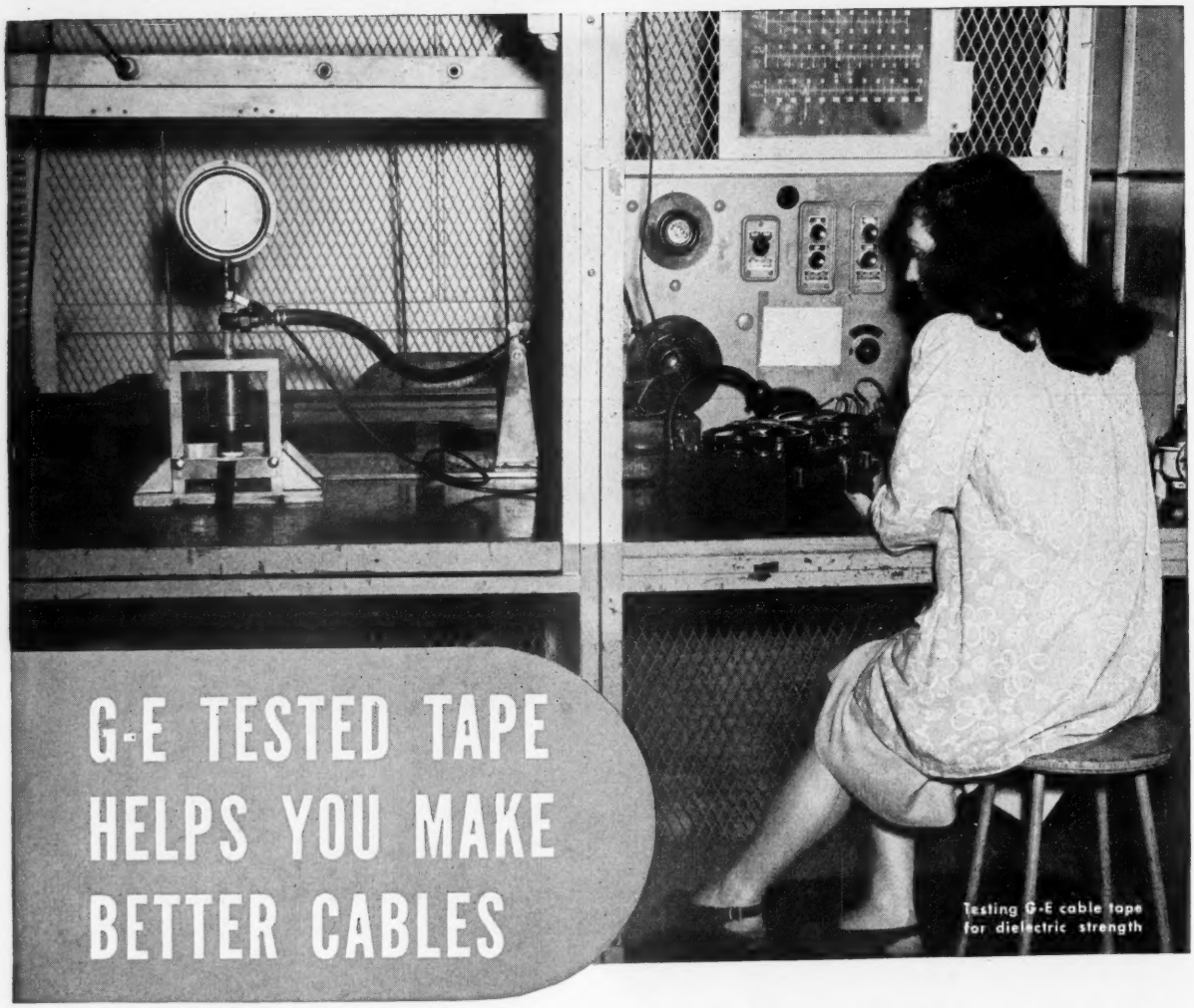

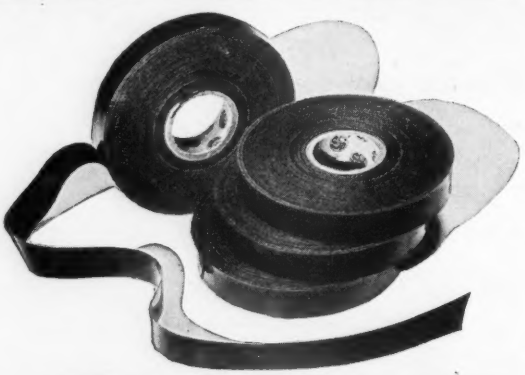

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Every yard of General Electric tape is tested to help insure the insulating qualities required in your cables.

G-E tests assure the dielectric strength . . . resistance to heat, chemicals and moisture . . . tensile and tearing strength . . . thickness and evenness of application of insulating varnish . . all of which are so highly important to good cable insulation. In addition to I.P.C.E.A. specifications, General Electric has established standards of quality which its tapes must meet.

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CD48-T2

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WITH our way of life threatened and even our motives for helping others discredited, we drift toward destruction of the very thing that makes America the envy of the world --individual liberty. Who can steer our course, to save our craft from wreck?

It is *your* job. You, as a leader in your community, must help arouse public opinion to a full appreciation of America's sacred heritage of freedom for the individual. You owe it to yourself, your family, your neighbor and your nation, to give of your experience and knowledge to pilot us safe through the storm.

These tempestuous times demand the intelligent work of leaders in every community to preserve America as the impregnable vessel of liberty and freedom. Here then, is important work for able helmsmen.

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MANUFACTURERS OF CARBON, ALLOY AND YOLOY STEELS

COLD FINISHED CARBON AND ALLOY BARS - SHEETS - PLATES - WIRE - TIE PLATES AND SPIKES - ELECTROLYTIC TIN PLATE - COKE TIN PLATE - PIPE AND TUBULAR PRODUCTS - CONDUIT - BARS - RODS.

HUDSON WIRE COMPANY

PRODUCERS OF FINE WIRES IN ALL METALS

FINE BARE WIRES

High Brass, Low Brass, Zinc 99.99+ and High Tensile Zinc, Commercial Bronze, Phosphor Bronze, Pure Tin, Lead, Antimonial Lead, Tinsel Lahns, Silver Plated Copper, False Gold and Copper.

Cadmium, Nickel Silver (10%, 18%, 30%), Silver Plated Copper, False Gold and Special Brass and Bronze Alloys to Specification, Metallic Fibre for Packing Purposes, Copper, Bronze, Zinc, Lead and Aluminum.

WIRES FOR METAL SPRAYING

Pure Lead, Lead Alloys, Pure Zinc, Zinc Alloy, Copper, Tin, High Brass, Low Brass, Solder Wire, High Conductivity Electric Wire.

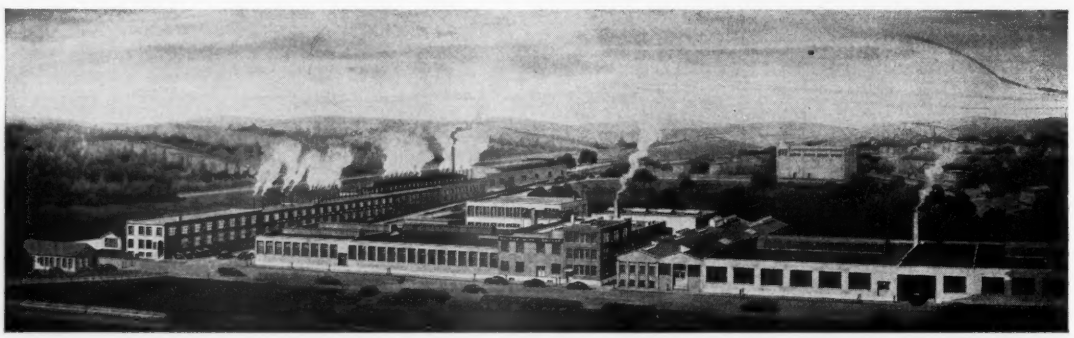
Cadmium, Nickel Silver (10%, 18% 30%), Aluminum, Monel Metal, Phosphor Bronze, Pure Nickel, Commercial Bronze.

Look for the name — **HUDCO** — A guarantee of quality

"HUDCO" specially processed Copper Wire for enamelling purposes is drawn from Selected Copper, insuring the maximum conductivity. This is but one example of the use of the most advanced and approved materials and methods in our processing.

BETTER WIRE AT LOWER COST

Write for Prices and Samples • Let Us Quote on Your Requirements



"HUDCO" PLANT AT OSSINING, NEW YORK

HUDSON WIRE COMPANY

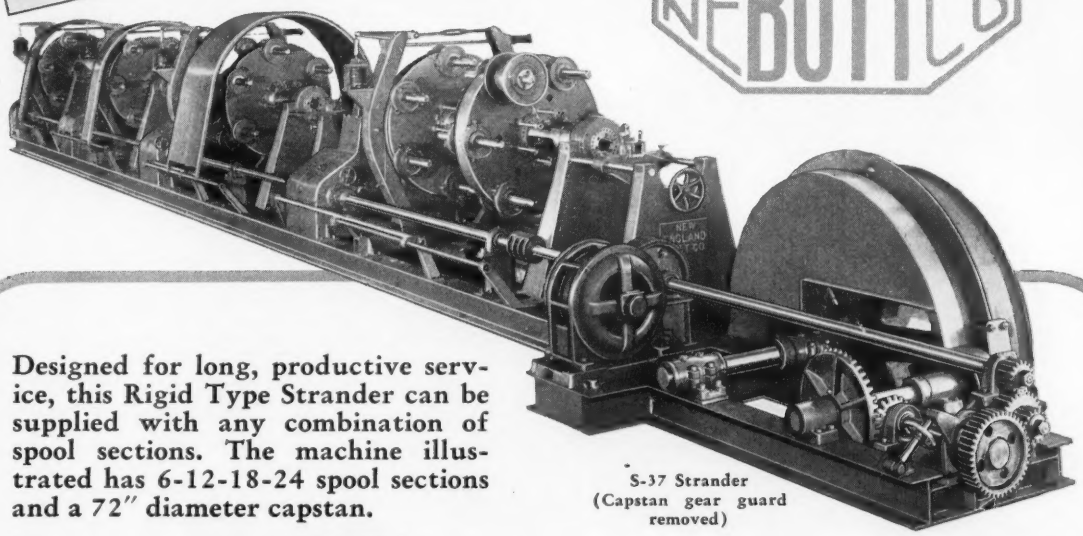
Established in 1902 — Successors to Royle & Akin

OSSINING, NEW YORK

for fast, uniform stranding

RIGID TYPE STRANDER

NEBUTT CO



S-37 Strander
(Capstan gear guard removed)

Designed for long, productive service, this Rigid Type Strander can be supplied with any combination of spool sections. The machine illustrated has 6-12-18-24 spool sections and a 72″ diameter capstan.

LOW MAINTENANCE

Anti-Friction Bearings on Line Shaft and Reel Mountings
Encased Drive Gearing operates in oil bath
Rugged plate steel welded construction
Large diameter Wire Guide Sheaves

AUTOMATIC CONTROLS

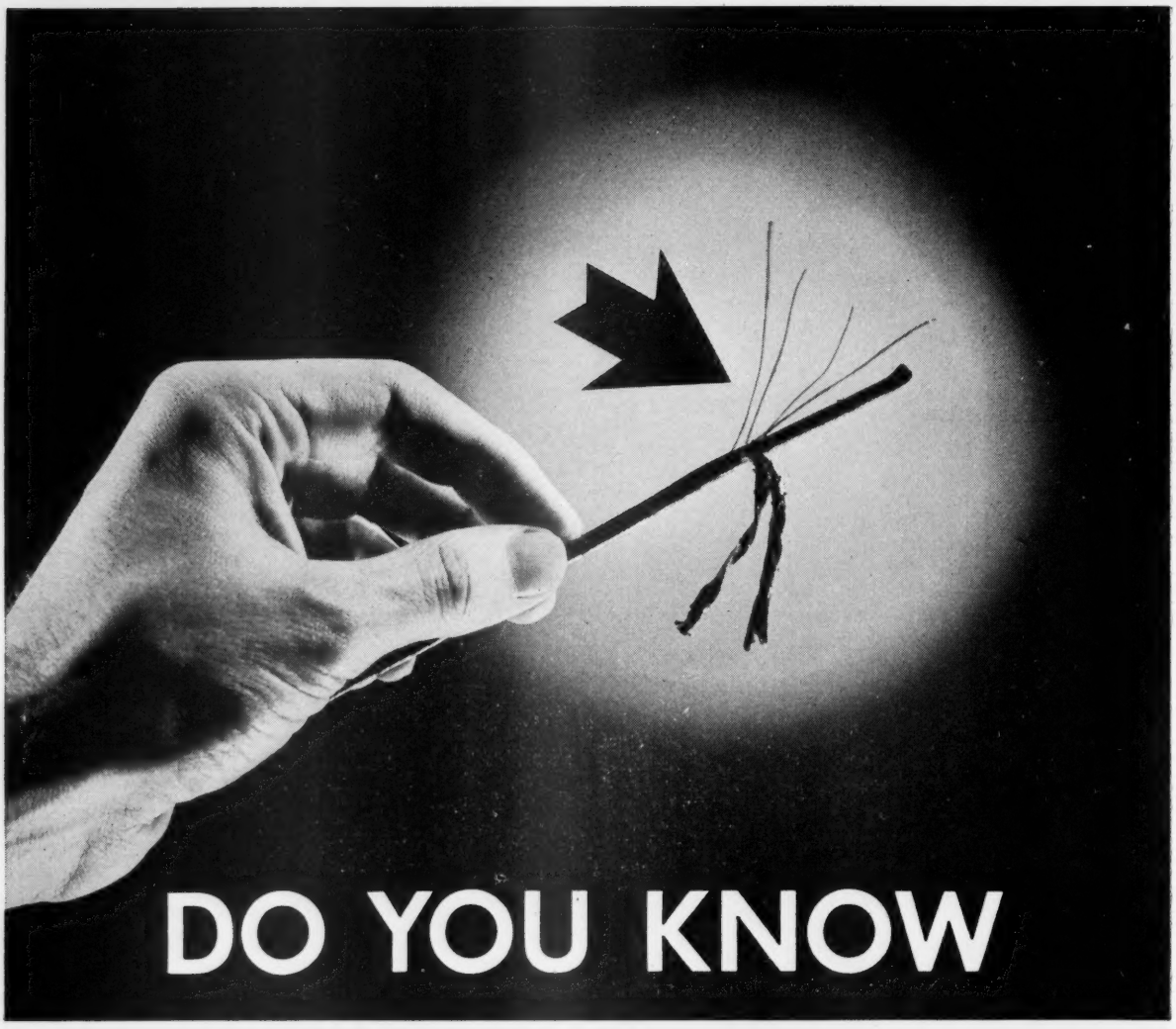
Stop Motion on each Wire
Solenoid Brakes

TIMESAVING SET-UP AND OPERATION

Quick-Acting Spool Locks
Each Head Reversible and Fitted with Speed Change

Write for further details and prices.

NEW ENGLAND BUTT COMPANY
Established 1842
304 PEARL STREET • PROVIDENCE 7, R. I., U. S. A.
JAMES DAY (MACHINERY) LTD., "FORD HOUSE", 88 REGENT ST., LONDON, W. 1, ENGLAND



. . . these three reasons why Fiberglas* 150's yarns are being used as binder yarns on type R wire (wrapped construction)?

1. *Low Cost*—per unit length of wire.
2. *High Strength*—good application efficiency and strong binding of the wrap.
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TM. REG. U.S. PAT. OFF.
Yarns

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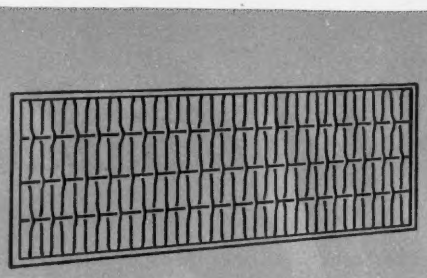
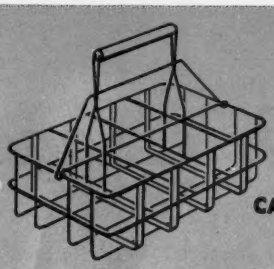
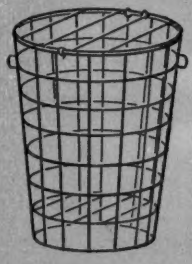


GRILLES

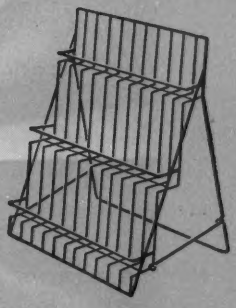


CARRIERS

Wire goods that never BLUSH from exposure...



RUBBISH CONTAINERS



DISPLAY RACKS

they're ALCOA ALUMINUM!

Your customers will never see red rust on wire articles fabricated from Alcoa Aluminum Wire. The natural bright finish of aluminum wire stays that way without requiring painting or plating. Or you can have Alcoa Aluminum Wire in any color of the rainbow by the patented Alumilite process that puts the color of your choice into the metal surface.

And watch sales increase when customers heft the light weight of aluminum wire goods. This light weight . . . ⅓ the weight of steel or brass . . . gives you 3 times as many feet of wire stock per pound of metal, cuts the cost of fabricated articles.

Fabricate aluminum wire on your present equipment. Weld it or braze it for tight, strong joints. Alcoa Aluminum Wire is made in all standard sizes and shapes. ALUMINUM COMPANY OF AMERICA, 1828 Gulf Bldg., Pittsburgh 19, Pennsylvania. Sales offices in 54 leading cities.

ALCOA FIRST IN ALUMINUM

ALCOA ALUMINUM 1888 1948 60 YEARS OF SERVICE

A Message to Advertisers...

You may sometimes ask — or the boss may — whether production men are interested in advertising.

The men on the firing-line, who are selling your machinery, equipment or supplies, (lubricants, wire, etc.) should be able to furnish you with a positive affirmative answer.

Your field men know that the production man is the one who is to be satisfied with new equipment or supplies. If products don't work, he is the one who holds the bag, having approved a purchase requisition.

Mill men make the final decisions on purchases, so that your printed advertisement is a means of keeping him informed, of making the introductions for your representatives, or, in many cases, doing the complete selling job, outside of actually signing the order. Sometimes it even brings signed orders without a representative's presence.

Advertising, whether or not for the moment you need business, is of paramount importance both to those who have or will have something to sell. The greatest mistake is to assume that your buyers have long memories. There is a psychological factor in your favor in continuous advertising that cannot be ignored. Those who don't advertise increase their selling costs; those who fall by the wayside because "oversold", lay up for themselves a painful day of reckoning.

Hence, our advice is to get up your advertising steam and keep it at working pressure for the day when plenty will be needed.

If the cap fits, you are invited to put it on!

We are ready and willing to do our part in keeping the production men of the wire industry informed as to what you are doing for them.

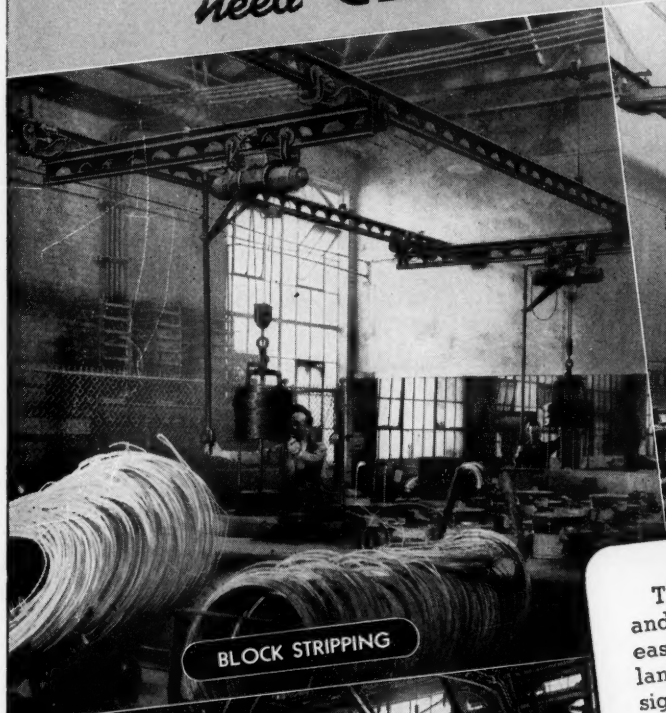
WIRE AND WIRE PRODUCTS

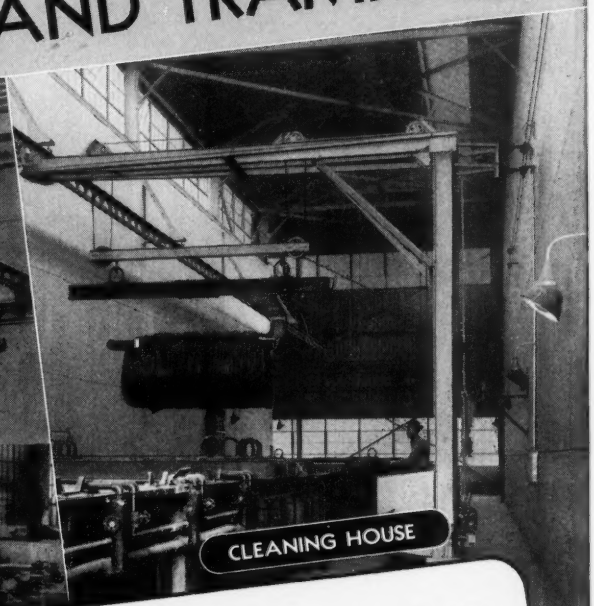
Edmund D. Sickels, Advertising Manager

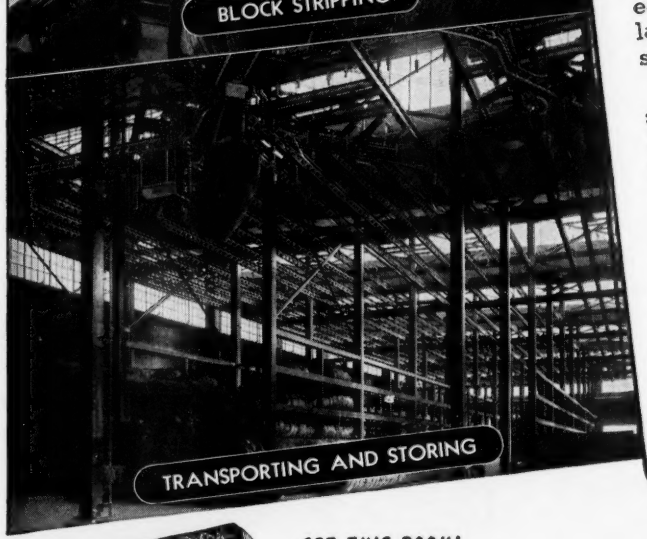
300 MAIN STREET STAMFORD, CONN.

Stamford 3-0482

ROD AND WIRE PLANTS *need* CLEVELAND TRAMRAIL







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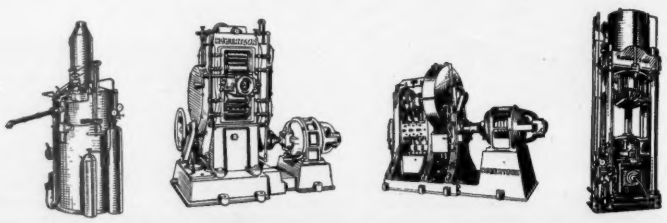

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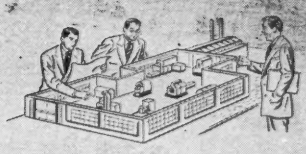

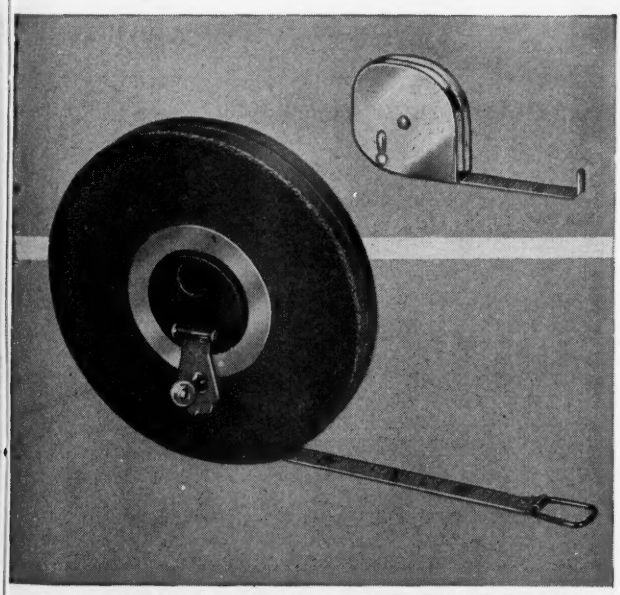

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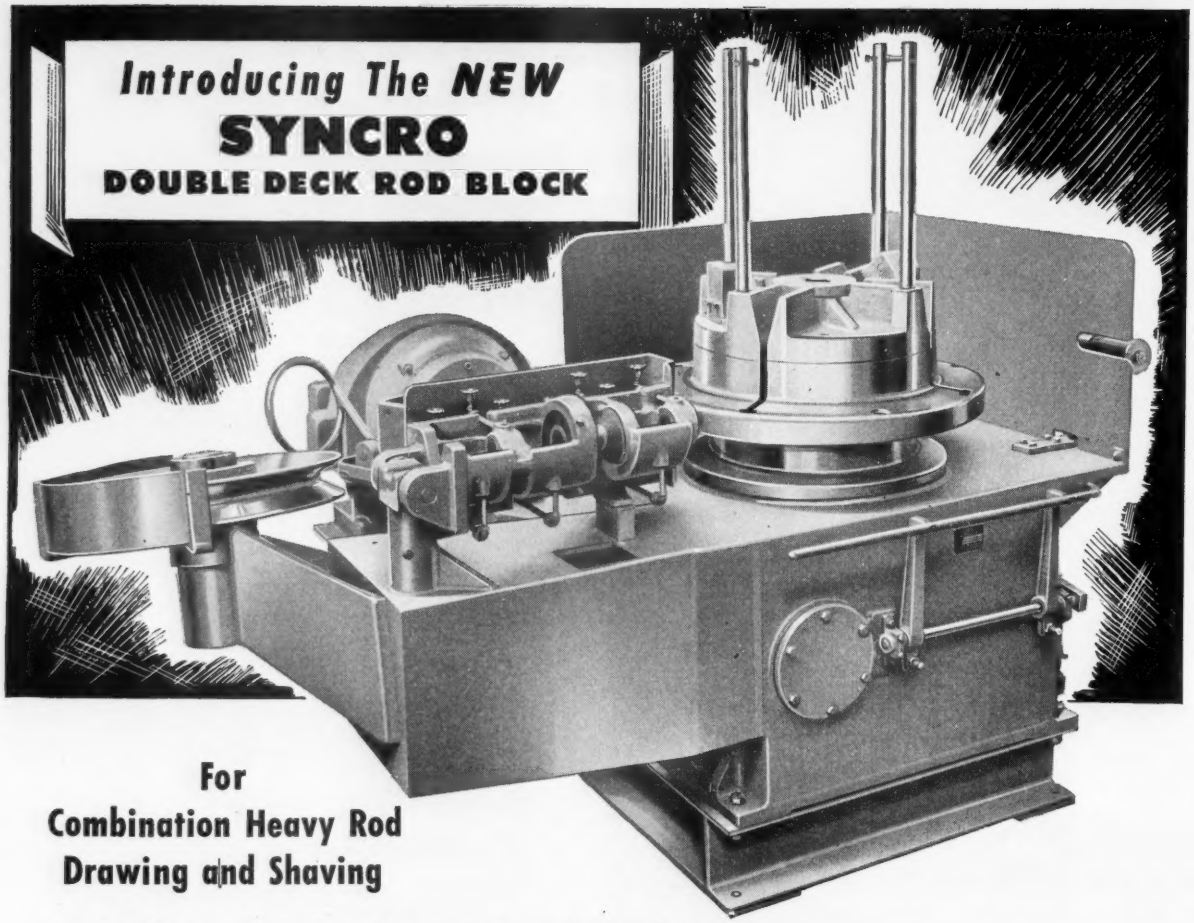

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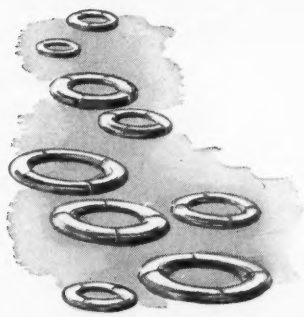

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The Chairman of the Program Committee, L. C. Crewe, has reported an exceptionally impressive array of technical papers on both ferrous and non-ferrous subjects and, whatever your interest in wire, you are bound to find one or more subjects of vital importance to you. Details regarding the program will be announced next month, so watch for forthcoming issues of WIRE AND WIRE PRODUCTS for information concerning, speakers, sessions, plant inspections and other features.

Your attention is particularly directed to the fact that in 1948 the program will occupy a full five days, instead of four, as heretofore. This is necessitated by the time required to cover the enlarged activities of the Association.

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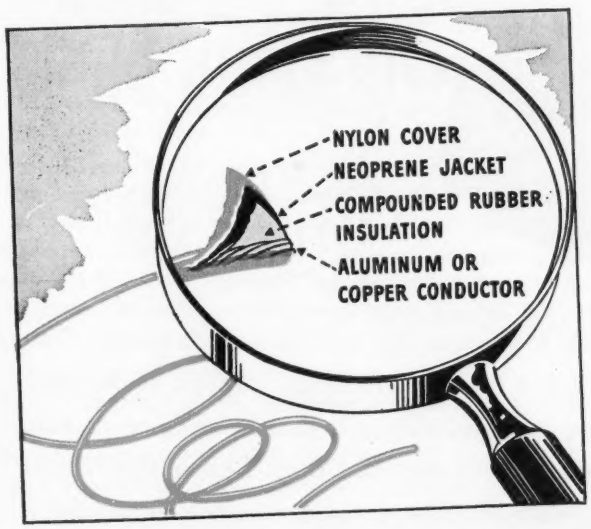
Why Du Pont NYLON covers U. S. Rubber's *Neolay* wire



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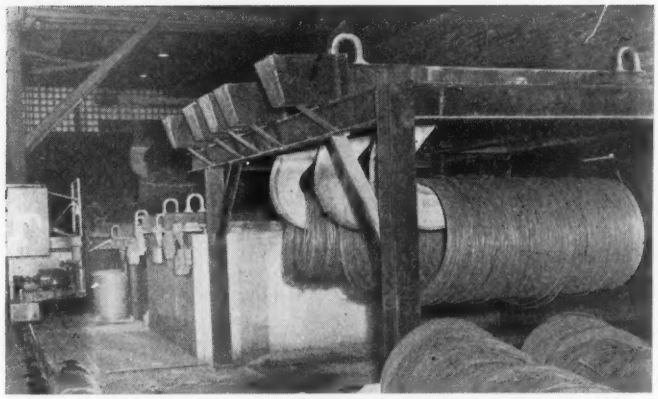
. . . The *Modern* Way of Drawing Wire with *Modern* Equipment is used at National-Standard



Photograph courtesy National-Standard Co.

Dry wire, coated with Magnus Metal Coat 267, on racks ready for drawing. Unlike lime-coated wire, wire coated with 267 can be stored indefinitely without rusting. Note the very clean floor.

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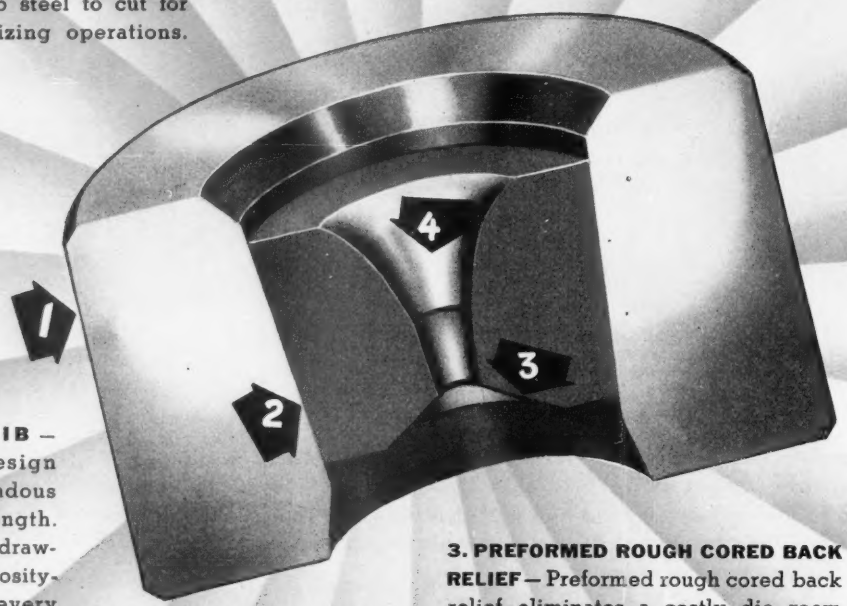

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The Wire Outlook

By whatever name called or for whatever reason justified, the third round of wage increases gradually spreading through industry is preparing the way for another spiral in the upward trend of prices.

It is to be deplored that labor leaders seem unaware that they are not improving the status of labor through their continuing demands for higher wages. Were this paralleled by as insistent a campaign for better workmanship and higher productive efficiency on the part of the men they "lead" and whose best interests they profess to represent, even now these wage scales probably could be justified and the cycle of higher prices be checked. Almost anyone who has purchased a new car since the termination of the war can testify to the downright inefficiency and sloppiness of today's standards of workmanship.

Let's assume that we can "take it", so far as our domestic economy is concerned. If it be true that long-range prosperity is dependent in part upon export markets, our labor policies are steadily, but surely pricing us out of foreign markets, except as we taxpayers pay for such business as may be returned to us through our foreign aid policies.

Production and distribution of goods continues at rates near the post-war peak, with much evidence of higher levels to come. Only in spots is business not good. In the wire industry, electric wire and cable and wire rope are the weak points at the moment, which is reflected in slow business for diamond die manufacturers and various insulating materials. This condition can only be temporary and when buyers become convinced that prices will not go lower, a rush of orders may be expected to take up the slack.

Union leaders are continuing to fight the check rein placed upon them by the Taft-Hartley law on the mythical ground of its injustice to labor, but actually because they resent the curbs placed on the undue license accorded them by the Wagner Act. Any woes from which the unions may feel that they are suffering, they have certainly brought upon themselves; most impartial observers agree that the union members themselves are better off than when a one-sided law allowed more license than was good for a sound economy.

Movement of scrap is continuing at reasonably high levels with the seasonal increase in supply and has resulted in less buying from remote points. Important tonnages of scrap from Japan are now being offered to American steel producers.

Copper, while in relatively easy supply, may become more difficult when the E. R. P. gets into full swing, due to a heavy world increase in demand. The lead, tin and zinc markets show no important changes, with demand for these metals continuing unabated.

No slackening in the overall demand for wire has been noticeable and total output of wire products remains high. Rod supply, especially to non-integrated mills, is limited with conditions in many small mills worse than last year. Producers report that deliveries are falling further behind schedules.

While bolt and nut demand still exceeds supply, particularly for the smaller sizes for machine and durable goods assemblies, backlogs are reported to be somewhat reduced. Mill deliveries on cold heading wire, wire coils and flats for nuts are showing little improvement.

Considering the political factors that normally affect business in an election year, the pent-up demand for the products of industry is so great that the usual confusion from this source is barely noticeable. Business men have struggled now for so many years with extraordinary and uneconomic influences, that it is more than likely that they will pull through this year's ordeal with flying colors.

—from the Editor's Desk

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No. Nor can you operate two wire machines as cheaply as one. Why support low producers that make your cost high? Throw out the laggards. Install fewer modern Morgan-Connors and obtain the same output at far less cost.
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A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable.
DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

VOL. 23 JULY, 1948 No. 7

Designated as
Official Publication By The Wire Association

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Publication Office: New York
Executive Office: Stamford Trust Co. Bldg., 300 Main St., Stamford, Conn.

Annual Subscription, U. S. $5.00, Canada $5.00

50 Cents a Copy in U. S. Issued Monthly Foreign, $7.50
October Convention Issue $1.00 a Copy
January Convention Discussions Issue $1.00 a Copy

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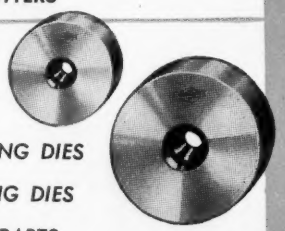

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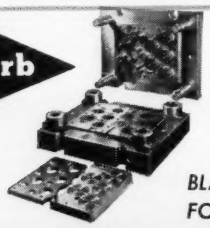

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WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip.
DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 23 JULY, 1948 No. 7

Sensitivity of Different Steels to Pickling Brittleness *

By C. A. Zapffe and M. E. Haslem
Consulting Metallurgist Research Chemist
Baltimore, Md.

Pickling and its concomitant, hydrogen embrittlement, present problems involving both theory and practice. An understanding of the theory should help to set up proper practices to overcome the condition.

Introduction

IN previous articles in this Journal, the phenomenon of hydrogen embrittlement was followed through its fundamental concepts[1], its occurrence in pickling and electroplating as detected by a special bend test[2], and, recently, its unique interrelationships with coldworking[3].

* * *

IN most of these tests, a single grade of steel wire provided the specimens: Type 440-C stainless steel (17% chromium-1% carbon). Since the purpose of the investigation was to compare processes, not steels, the steel as a factor was kept constant.

* * *

HOWEVER, the sensitivity to pickling brittleness is known to differ widely from steel to steel, and to vary in a generally unknown manner with metallic alloy content, carbon content, heat treatment (microstructure), and coldwork. Since the effect of coldwork has recently been discussed[3], the present research is addressed to a preliminary solution of the principal remaining factors: (1) alloy content, (2) carbon content, and (3) heat treatment.

* * *

HERE the theoretical importance of the study lies in identifying those factors within the steel which control hydrogen embrittlement; while the practical aim is to define the actual liability of various steels, in their various conditions, to pickling and plating brittleness.

* * *

ALTHOUGH variables within the pickling solution must also be carefully regarded, the master charts here presented comparing data from various steels will allow useful prediction of the stature of a possible pickling brittleness problem which a plant might encounter in changing to, or installing, the processing of a new grade or type of steel. For example, a plant accustomed to the handling of carbon steel wire could use these charts to advantage if an operation developed requiring stainless steel. And a stainless steel plant undertaking to process a new grade, or a common grade in a new condition, could predict from these charts the trouble likely to be encountered, if any. There is another practical usefulness of the data in that they may reveal to the plant operator susceptibility to hydrogen not previously recognized; whereby a correction of his processing could importantly reduce breakage of the wire in drawing, or coiling, or such operations as coldheading, wherein failures have possibly previously been blamed on an inherent lack of ductility in the metal itself.

* * *

Cathodic Versus Acid Pickling

JUST as in the previous studies it was important to control the steel and vary the process, here it is necessary, conversely, to control the process and vary the steel. Consequently, the research begins with an exploration of the behavior of the steels under conditions of cathodic pickling. Cathodic pickling is selected because it employs a variable cathode, which can be the steel under consideration, upon whose surface the concentration of hydrogen can be readily held constant from test to test by fixing the current density. The only variables therefore solely concern the steel;

*From research conducted in the laboratory of the senior author in conjunction with an Office of Naval Research contract on gas-metal systems.

TABLE I

DESCRIPTION OF STEELS TESTED*

Specimen	Analysis	Thermal Treatment	Mechanical Treatment (% Red. in Area)	Ultimate Tens. Str. (psi.)
SAE 1020	C = 0.18 Mn = 0.60 Si = 0.17			
I		No. 5 gage green rod drawn six holes to 0.062 in. ø		170,000
SAE 1060	C = 0.60 Mn = 1.00 Si = 0.18			
I		No. 5 gage green rod drawn 2 holes to No. 9 gage, air-patented and redrawn 5 holes to 0.062 in. ø		243,000
SAE 1090				
I	—	Grade E Music Wire		— —
ISI 302	Cr = 18.26 Ni = 9.11 C = .056			
I		Annealed	—	— —
II		"	Cold-drawn	— —
ISI 303	Cr = 18.30 Ni = 9.13 C = 0.06 S = 0.266			
I		Annealed	—	— —
II		"	Cold-drawn	— —
ISI 410	Cr = 12.52 C = 0.125			
I		Annealed	—	73,000
II		"	7.0	80,000
III		"	58.5	123,000
IV		Hardened and stress-relieved	—	188,000
V		"	26.0	222,000
VI		"	46.0	232,000
ISI 420	Cr = 13.18 C = 0.36			
I		Annealed	—	— —
ISI 431	Cr = 16.34 Ni = 1.68 C = 0.16			
I		Annealed	—	95,000
II		"	18.0	115,000
III		Hardened	—	208,000
IV		"	17.5	240,000
ISI 440-A	Cr = 17.60 C = .64			
I		Annealed	—	— —
ISI 440-C	Cr = 17.08 C = 1.08 Mo = 0.52			
I		Full Anneal	—	102,000
II		Process Anneal	29.0	104,000
IIa		" "	—	— —
III		Hardened and stress-relieved	—	263,000

*All specimens 0.060 ± .002-in. ø

and the results disclose directly those conditions of the metal which favor or disfavor hydrogen absorption and embrittlement.

* * *

IN the second section of the study, however, these tests are repeated using straight acid pickling. This is done, first, because of the practical aspects of the data; and, second, because of the interesting differences which might show up when the surface concentration of hydrogen is controlled by chemical attack, rather than by fixed electrical characteristics.

* * *

FOR example, mild steel and stainless steel in cathodic pickling are equally bombarded with hydrogen atoms, or ions; but in acid pickling the difference in the resistance of the two steels to metal attack obviously unequalizes the two hydrogenizing conditions. The results from cathodic pickling cannot therefore be applied directly to acid pickling; and the results from acid pickling must depend considerably upon this factor of metal attack, which is absent in cathodic pickling.

* * *

FROM the cathodic pickling experiments, then, there should appear the **true** effects of such factors within the steel as alloy content, heat-treatment, and coldwork; and from the subsequent series of tests with acid pickling there should result measurements of the **actual** liability of the steels to brittleness from straight acid pickling — representing the fundamental liability of the metal as revealed by cathodic pickling, modified by the factor of metal attack.

* * *

Steels Studied

TABLE I lists the steels studied in this research. These include (1) plain-carbon steels over a range of carbon contents, and in the cold-drawn condition, (2) hardenable stainless steels over a similar range of carbon content, and in several conditions of heat-treatment and coldwork, and (3) nonhardenable austenitic stainless steels, both annealed and cold-drawn.

* * *

VIRTUALLY the entire field of stainless steel is surveyed, for the specimens are representative grades; and extremes of annealing, hardening, and coldwork are studied. Less exhaustive are the studies of the carbon steels, which were included principally as representative specimens for comparison with the stainless steels on the basis of corresponding carbon contents. Their condition is uniformly "air-patented" and cold-drawn.

* * *

Pickling Baths Studied

IN the cathodic pickling experiments, a 10% c.p. NaOH solution in distilled water is always used, with a current density of 1.0 amp./in.^{2} and a temperature of 50°C (122°F), unless otherwise specified.

* * *

IN the acid studies, commercial pickling compositions are followed; but c.p. acids are used, and no inhibitor or other reagent is added. The acids include: sulfuric (H_2SO_4), hydrochloric (HCl), phosphoric (H_3PO_4), acetic (CH_3COOH), nitric (HNO_3), hydrofluoric (HF, and HF/HNO_3 mixed acid under conditions that will be described. The omission of inhibitors and other reagents is necessary in these preliminary studies for accurate testing, as will be clearly understood when a later article discloses the powerful and unexpectedly contrary effects of such additions on hydrogen absorption.

* * *

INDEED, it should be clearly recognized here that the present data only disclose those specific factors under observation, unobscured by numerous complications which might develop under plant pickling conditions. The present ones are prominent factors; but the more doctored the pickling solution, or the more carelessly handled, the less the significance of the present data to plant experience.

* * *

Test Method

FOR studying the embrittlement as expressed in bend values, the machine and technique described in the previous publication[2] are employed. Briefly, the method involves bending an 0.06-in. ø wire around an 0.06-in. radius in a single bend driven by a special mechanism at a constant rate of 5 degrees of arc per second. All graphs depict bend values on the ordinate progressing up to 180 degrees, the limit of the instrument, and a value indicating excellent ductility. Large circles represent the specimen tested 30″ after hydrogenizing, and small circles the duplicate at 90″. Stainless steel specimens are generally indicated by white circles, carbon steel by black circles.

* * *

RESULTS WITH CATHODIC PICKLING

Austenitic Stainless Steel (Chromium-nickel)

TYPE 302, the popular "18-8", and Type 303, "free-machining 18-8", were cathodized in both the annealed and the coldworked conditions at temperatures from 20°C to 80°C (68°F to 177°F) and for four-hour periods without registering embrittlement[4].

* * *

THIS does not mean that these steels do not embrittle. The ductility of all the austenitic steels is very high, for the reason that the crystal structure known as "austenite" (face-centered cubic) is one of the most amenable to coldwork of all metallic structure. Also, this particular crystal structure has a greater chemical affinity for hydrogen than does the other crystal form of iron (body-centered cubic "ferrite") which means that for a given hydrogen content there will be more atoms harmlessly dissolved among the iron atoms, and accordingly less available for the harmful precipitation along slip planes which is the phenomenon of hydrogen embrittlement[1], [3].

* * *

IN the casting of ingots, these austenitic steels freeze in the mold with a minimum tendency toward gassiness, for this same reason that they "hold" their hydrogen; whereas "bleeding" is a serious problem with the ferritic stainless steels[6], whose crystal structure is not a good host to hydrogen and rejects it as gas bubbles on freezing, and as slip-plane occlusions at ordinary temperatures[1], [3], [6].

* * *

WE may thus conclude that austenitic stainless steels are

highly resistant to hydrogen embrittlement, though not necessarily immune.

* * *

Martensitic Stainless Steel (High-carbon)

WHEN carbon from 0.30 to 1.00 per cent is added to straight chromium grades of stainless steel, great hardening characteristics are derived which, in conjunction with a fair retention of "stainlessness", make the steel especially suited for cutlery, surgical instruments, springs, valve parts, and so forth. Common experience, however, is that such steels are more liable than any to hydrogen embrittlement; and this is confirmed by the work to date on Type 440-C[3].

* * *

BY grade numbers, these highly hardenable steels increase in carbon content as follows: Type 420 (.35% C); Type 440-A (.60% C), Type 440-B (.80% C), and Type 440-C (1.00% C). In the fully annealed condition, Types 420 and 440-A (see Table I) showed no embrittlement even after 4 hours' charging. The marked embrittlement of Type 440-C, however, has already been discussed[3].

* * *

CONSEQUENTLY, carbon in the hardenable steels seems to increase susceptibility to embrittlement **even when the steel is fully annealed.** This fact warrants special mention; for although it is common knowledge that increasing carbon causes increasing susceptibility when the steel is **hardened**, no such information is available for steels in which the carbon is in the condition of agglomerated carbides.

* * *

Comparison of Carbon Steels with Hardenable Stainless Steels*

BECAUSE of this observation on the effect of carbon in annealed stainless steel, the carbon steels listed in Table I were particularly obtained to provide comparable changes in carbon content, but with no chromium present. While not similarly fully annealed, the "air-patented" microstruture is essentially a ferrite-carbide constitution; and any divergence would logically err on the side of increased susceptibility, as proved earlier with respect to the effect of prolonged annealing on susceptibility to embrittlement[3].

* * *

IN Figure 1, the results for the carbon steels containing carbon in the range up to that of the Type 440-C stainless steel show a completely contrary behavior. The SAE 1020 steel (.18% C) embrittled badly; the SAE 1060 (.60% C) resisted embrittlement for more than one hour; and the SAE 1090 (about .95% C) could not be embrittled with two hours' charging.

*From work in Ref. 7

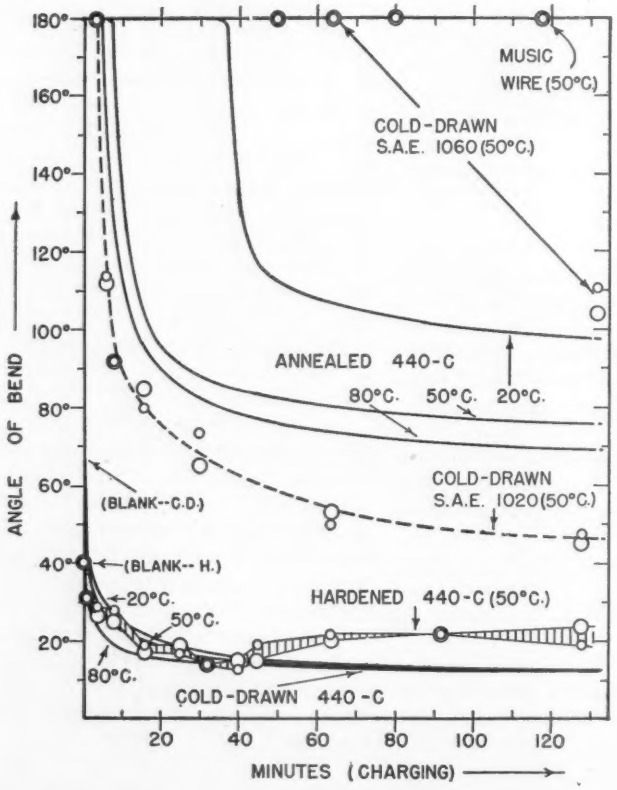


Fig. 1. — Chart comparing the susceptibilities of carbon steel and stainless steel to hydrogen embrittlement during cathodic pickling. * *

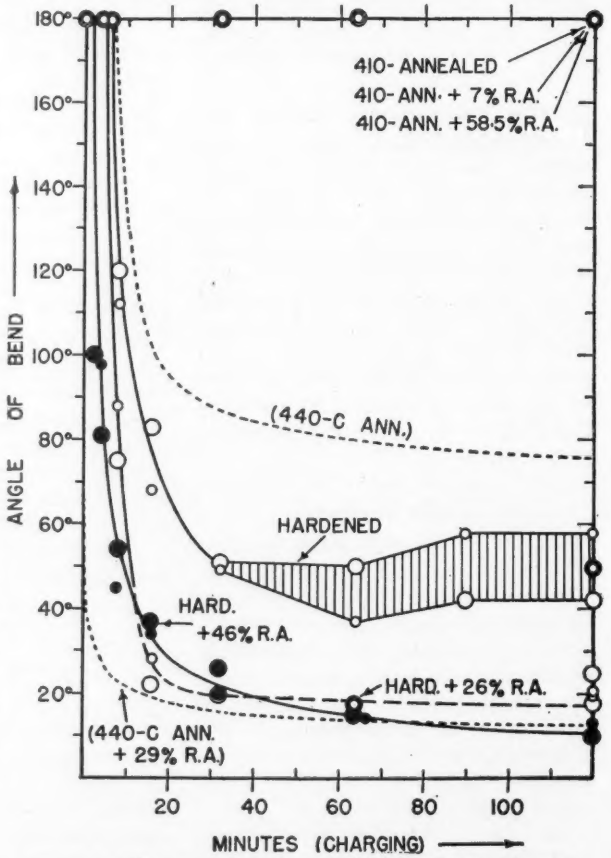


Fig. 2. — Chart comparing the susceptibilities of low-chromium low-carbon (Type 410) and high-chromium high-carbon (Type 440-C) stainless steels during cathodic pickling. * * * * *

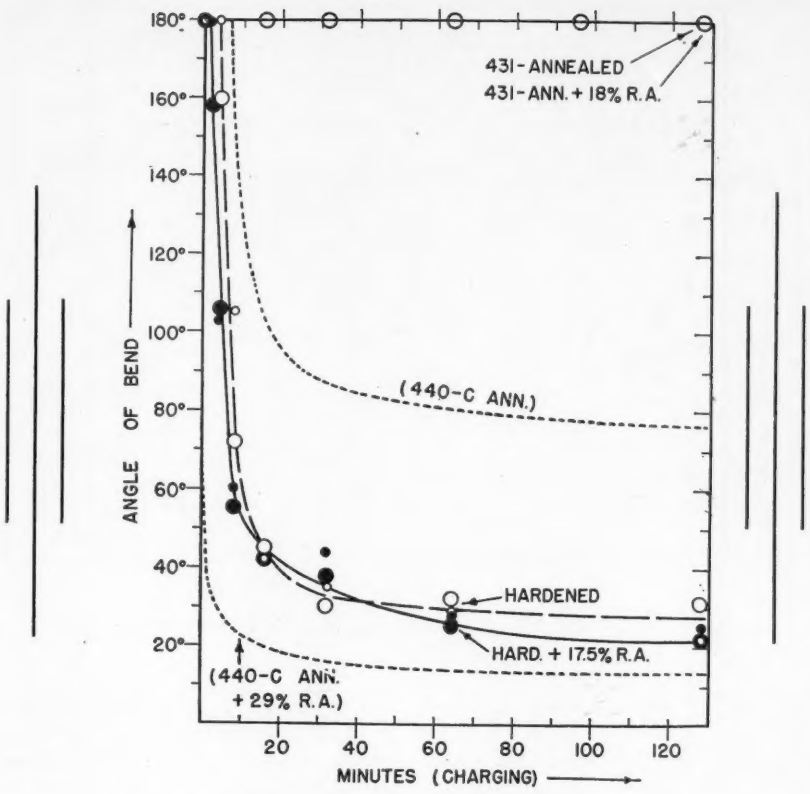


Fig. 3. — Comparison of stainless steels 431 and 440-C with respect to embrittlement from cathodic pickling. * * * * *

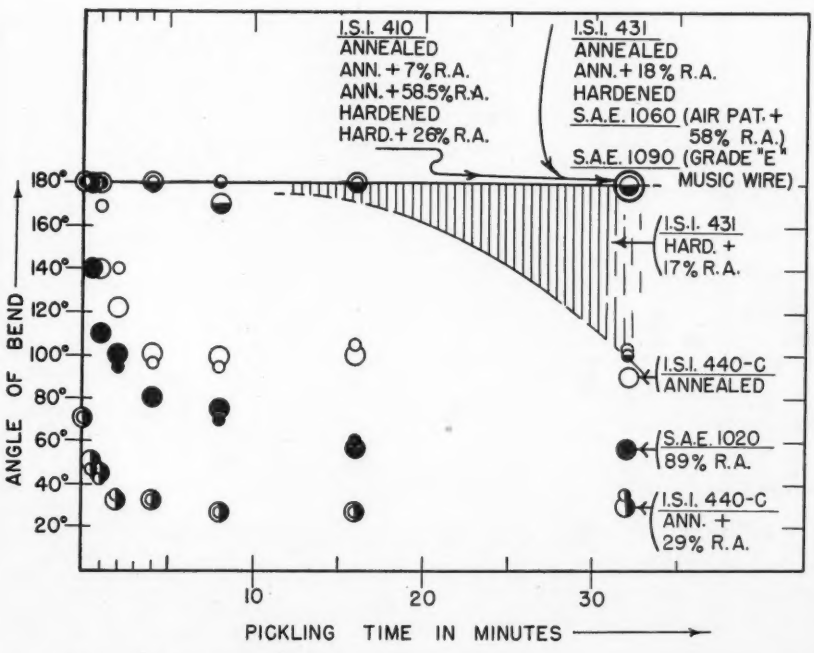


Fig. 4. — Master chart for sulfuric acid pickling (10%). * * * * *

ON the same chart are reproduced the three charging curves for fully annealed Type 440-C taken from the previous paper[3]. The curve for SAE 1020 lies below all three; but SAE 1060 and 1090 lie along the full-bend line with Type 420 and 440-A annealed stainless.

* * *

ACCORDINGLY, we have two exactly opposite effects of carbon content in the two types of steel, the presence of some 14-17% chromium in the stainless steels reversing the effect of carbon in unalloyed steel. No answer is yet at hand for this anomaly. In the hardened condition, both types of steel are known to increase rapidly in susceptibility to hydrogen embrittlement with increasing carbon content, witness the susceptibility of thermally hardened spring material.

* * *

ON the same chart are shown the hydrogenizing curves for 440-C in the annealed-cold-drawn condition, and in the hardened, or martensitic, condition. In both cases the blank values are very low; and embrittlement follows immediately on hydrogenizing. The great decrease in bend value of annealed 440-C caused by coldwork, observed in Figure 2, places further emphasis on the unusual resistance of SAE 1090 to embrittlement, for the cold-working of that material is even more severe than for the 440-C and should much increase its susceptibility[3].

* * *

IN its practical aspects, then, one can conclude from these tests and from general experience with hardened steel that increasing the carbon content of hardenable stainless steel increases the susceptibility to hydrogen embrittlement whether hardened or annealed; but with unalloyed steel this is only true for thermally hardened material, and is **inverse** for steel which is not thermally hardened. The "air-patented" wire, in which spring characteristics are developed by coldwork instead of by a hardening heat-treatment, consequently has avoided the embrittlement problem with remarkable efficacy.

FACTORS AFFECTING THE SUSCEPTIBILITY OF HARDENABLE STAINLESS STEELS

440-C Stainless Steels

CONFINING attention to the hardenable stainless steels, one can quickly confirm the previous conclusion regarding carbon content by studying the least hardenable steel in that class. This is Type 410, which contains a minimum chromium content for stainlessness (about 12%) and a minimum carbon content for useful thermal hardening (about 0.12%).

* * *

FIGURE 2 shows that this steel is not measurably affected by hydrogen when in the annealed condition. This is consistent with the results for Types 420 and 440-A. Nor does embrittlement become measurable for Type 410 even when the annealed steel is coldworked as much as 58.5%. Although the next higher grades in carbon, Types 420 and 440-A, were not tested in the coldworked condition, one can reasonably interpolate between these results for 410 and those for 440-C and predict that susceptibility might begin to show itself to a limited extent in these grades, annealed and cold-drawn, in the order of their increasing carbon content: (410), 420, 440-A, 440-B, (440-C).

* * *

IN Figure 2 there are also shown the hydrogenizing curves for Type 410 in the hardened and in the hardened-and-cold-drawn conditions. As may be seen by the blank value in the chart, Type 410 still bends 180° after hardening and cold-drawing, such as 440-C in the annealed condition.

* * *

NOTE that **hardened** 410 reacts to hydrogenizing much like **annealed** 440-C, showing only slightly greater embrittlement; and that coldworking progressively increases this susceptibility until values are reached which are as low as those for any of the grades. Particularly interesting is this fact that Type 410 bends 180° in the hardened and cold-drawn condition, in contrast to a bend value of only 40° for hardened 440-C, but that prolonged hydrogenizing brings both steels to the same low angle of bend. In proportion to the original ductility, therefore, hydrogen is much more damaging to hardened and cold-drawn 410 than it is to hardened 440-C.

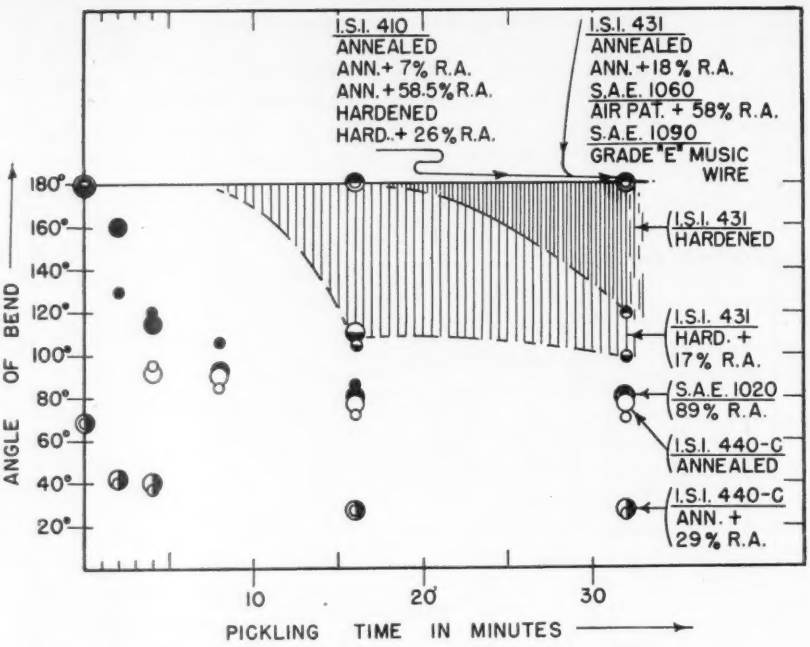


Fig. 5. — Master chart for hydrochloric acid pickling (5%). * * * * *

* * *

OTHER features of these curves are of interest; and they undoubtedly contain information not yet explored. In both Figures 1 and 2 there appears to be an uprise in bend value for the hardened steel after prolonged hydrogenizing periods, associated with an uncommonly great spread in the points. This may relate to removal of some surface carbon, perhaps as methane, by the nascent hydrogen.

* * *

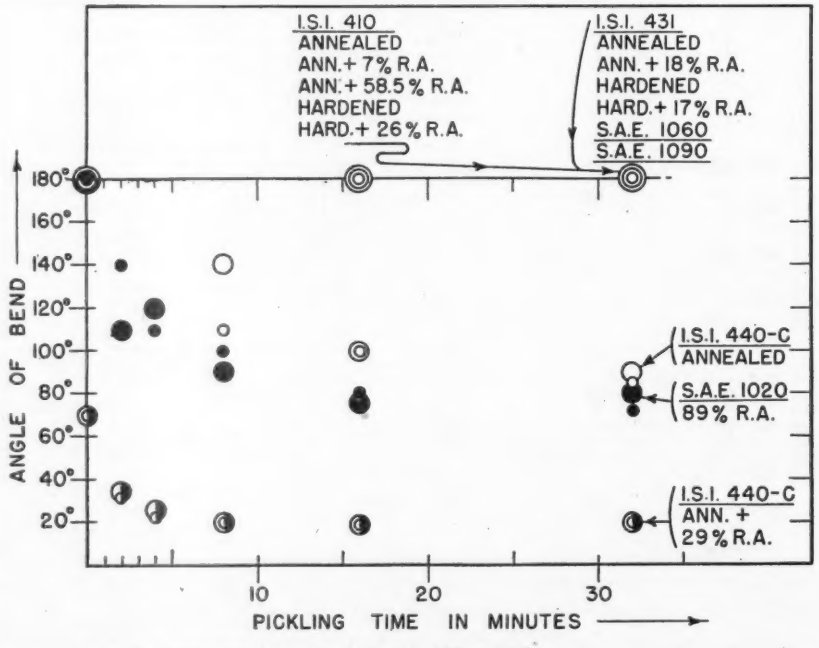


Fig. 6. — Master chart for hydrochloric acid pickling (50%). * * * * *

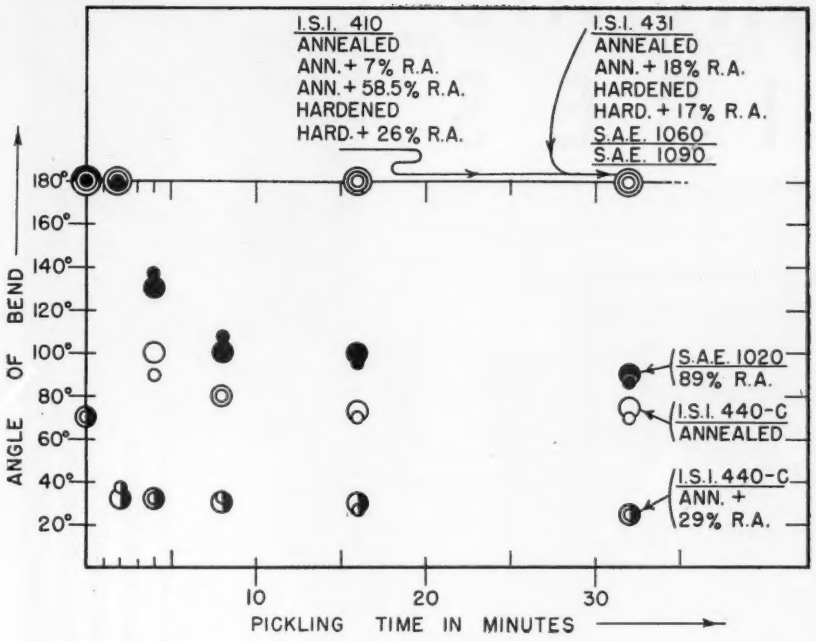


Fig. 7. — Master chart for phosphoric acid pickling (4-N). ★ ★ ★ ★ ★

Comparison of Types 431 and 440-C Stainless Steels

IF one retains the carbon content of Type 410 (about 0.12%) and increases the chromium content (12%) up to the range for Type 440-C (16-17%), the alloy becomes ferritic and largely loses its ability to harden thermally. If 1 or 2% of nickel is now added, however, the alloy reverts to a large extent to the hardenable austenitic (martensitic) condition. This is the commercial Type 431 alloy, a useful spring material.

★ ★ ★

IN commercial annealing of this "16-2" (16% chromium — 2% nickel) and the similar "12-2", or Type 414, cracked ammonia atmospheres have been tried for prevention of oxidation. Severe embrittlement of the wire usually developed, however; and its cause will now be seen obviously to be the hydrogen content of the gas.

★ ★ ★

SENSITIVITY of Type 431 to hydrogen embrittlement is disclosed in Figure 3. Once again the dotted curves for Type 440-C are included for reference.

★ ★ ★

NOTE that this steel, like 410, is not susceptible in the annealed condition even when cold-drawn. This observation is especially significant because of the susceptibility of 440-C, which has the same chromium content. In the annealed state, then, it is the carbon and not the chromium which brings susceptibility to 440-C. On the other hand, in the absence of chromium (see the previous Figure 1) carbon exerts exactly the opposite effect; and this remains a mystery.

★ ★ ★

ALSO like 410, Type 431 can be bent 180° in the hardened and in the hardened-and-cold-drawn conditions, but fails rapidly under conditions of hydrogenizing. The principal distinction between 410 and 431 seems to be that hardened 431 plunges to lower bend values, and that these are virtually unaffected by coldworking, except for a slightly earlier response to embrittlement of the cold-drawn material.

★ ★ ★

RESULTS WITH ACID PICKLING* Sulfuric Acid

TO disclose the reaction of these same representative steels under conditions of straight acid pickling, the following charts are presented.

★ ★ ★

IN Figure 4 the data concern pickling in 10% H_2SO_4 at 75°C (150°F). This temperature was chosen for all tests in this group as a standard which compromises the commercially useful temperatures, for example, between sulfuric acid and the more volatile acids, such as HF. With temperature constant, and bath composition constant (no additions), the course of pickling brittleness with increasing pickling

(*Please turn to page* 609)

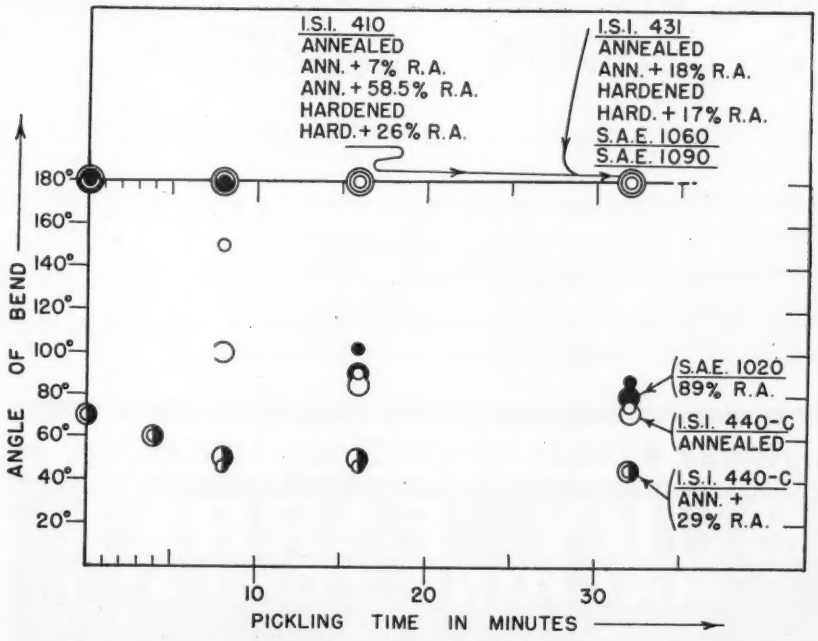
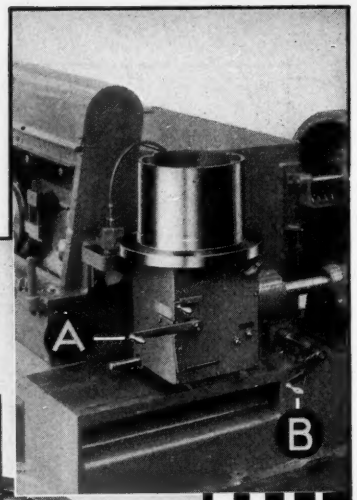
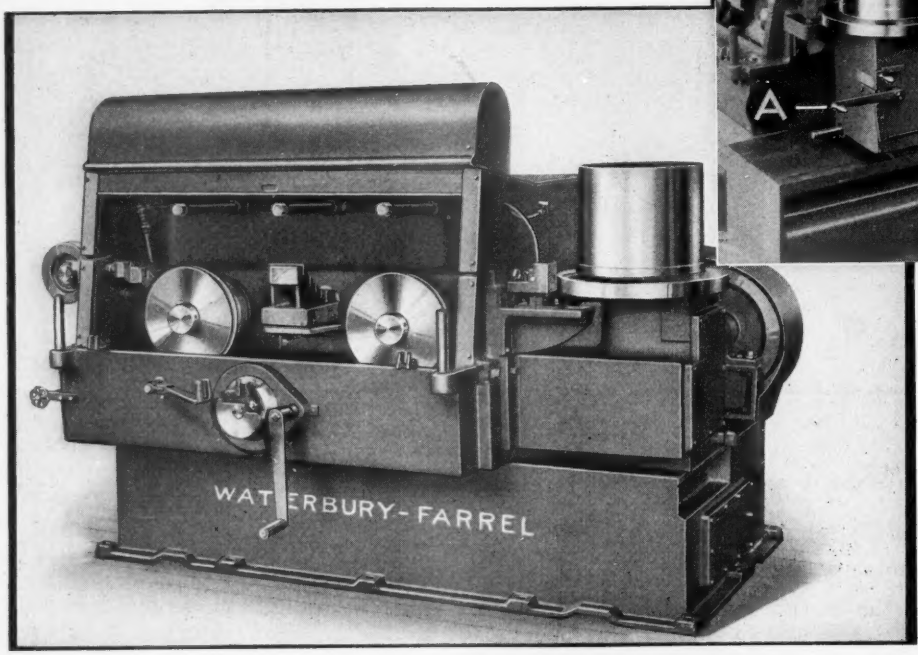


Fig. 8. — Master chart for acetic acid pickling. (4-N). ★ ★ ★ ★ ★ ★

*From work in Ref. 8.

WIRE DRAWING MACHINES





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Corrosion by Molten Materials

PART II

Compiled by F. R. Morral, Metallurgist

American Cyanamid Company

Stamford, Conn.

NOTE: Any reader, possessing additional qualitative or quantitative data on this subject would assist in the next revision of these tables, if he would put such information at the disposal of the writer.

SUBJECT INDEX

Introduction

I. Molten elements — mostly metals.

II. Molten Salts.

III. Molten Salt Mixtures.

References.

References were published at the end of Part I in the June, 1948 Issue of Wire and Wire Products.

TABLE II

CORROSION IN MOLTEN SALTS

Alum	18 Si, Fe	<2.4 at 200° C.	1
	16.9 Si, .59 C, .88 Mn, .25 Al, Fe	<2.4 at 200° C.	1
	14–16 Si, .65-1.0 C, .30 Mn	<24 at 200° C.	1
Ammonium carnallite	14 Si, C, Fe Forging Iron	Recommended to 400° C.	1
Ammonium Nitrate 169.7° C.	Aluminum	.04 at 180° C.	1
Ammonium Sulfate 513° C.	Iron	Strong attack	
Arsenic acid	Silver	Recommended	1
Barium Chloride 962° C.	Iron (See Table III)	Ofen usable	1
	Highly basic firebrick	Recommended	1
Barium Hydroxide 78° C.	Platinum	Not recommended	1
Barium Peroxide 800° C.	Iron	Not recommended	1
	Silver	Strong attack	1
	Gold	Strong attack	1
	Platinum	Strong attack	1
Benzoic Acid 121° C.	14-16 Si, .65-1. C, .30 Mn, Fe	1.56 at 130° C.	1
	14 Si, C, Fe	1.56 at 130° C.	1
Boric acid 185° C.	Cr — Al Steel	Not recommended	1
	Cr — Si steel	Not recommended	1
Cadmium Chloride 568° C.	Platinum (0_2 free)	Recommended if salt pure	1
Calcium Carbide 2300° C.	Iron	Recommended	1

Calcium Chloride 772° C.	**Iron**	**Strong attack**	**1**
	Copper	**Little too strong attack**	**1**
	Lead	**Strong attack**	**1**
Carnallite	**Ambrac (75 Cu, 20 Ni, 5Zn)**	**Best material up to 700° C.**	**1**
Iron Sulfate	**Gold**	**Attacked**	**1**
Hydrochloric Acid	**Cast iron @ 932° F**	**0.40 IPY**	**19**
	Cast iron @ 1292° F	**3.03 IPY**	**19**
Lithium Hydroxide 450° C.	**Platinum**	**Not recommended**	**1**
Lithium Carbonate 618° C.	**Platinum**	**Not recommended**	**1**
Paraffin	**Stainless steel 302**	**Not attacked**	**4**
	316	**Not attacked**	
	430	**Not attacked**	**4**
	410	**Not attacked**	**4**
Picric acid 125° C.	**Pure aluminum**	**Recommended**	**1**
	Copper	**Strong attack at 125° C.**	**1**
	Monel	**Not recommended**	**1**
	Zinc	**Strong attack at 125° C.**	**1**
	Tin	**No attack at 125° C.**	**1**
Potassium bisulfate 210° C.	**Pt-Ta alloy**	**Recommended**	**1**
	Platinum	**Not recommended**	**1**
Potassium bromate 370° C.	**Platinum**		
	Tantalum	**Recommended**	**1**
Potassium bromide 730° C.	**Silver**	**Strong attack**	**1**
Potassium Carbonate 891° C.	**Monel**	**No attack**	**1**
	Gold	**Little attack**	**1**
	Platinum	**Little attack**	**1**
Potassium chlorate 368° C.	**Platinum**	**Attacked**	**1**
Potassium chloride 790° C.	**Cr. cast iron**	**Recommended**	**1**
	Inconel	**Not recommended**	
	Silver	**Strong attack**	**1**
	Highly basic fire brick	**Recommended**	**1**
	Quartz	**Recommended**	**1**
Potassium cyanide 624° C.	**Iron (See Table III)**	**230 at 750° C.**	**1**
	0.6 C steel	**362 at 750° C.**	**1**
	.2 — .9 Cu steel	**~230 at 750° C.**	**1**
	Cr. steel	**~280 at 750° C.**	**1**
	Chrome plate	**Resistant**	**24**
	Monel	**Strong attack**	**1**
	Platinum	**Attacked**	**1**
Potassium Cyanate	**cr steel**	**at 780°F. .08 — .42 IPY** **at 975°F. .53 IPY**	

Potassium Hydroxide 360° C.	18 Si, Fe	>240 at 360° C.	
	14 Si, C, Fe	>240 at 360° C.	1
	14 Ni, 6 Cr, 5 Cu, 1.22-2 Si, 1-1.5 Mn, 2.7-3 C, Fe	Recommended at high temperatures	1
	2 Ni, 1 Si, 3.3 C, Fe	Recommended	
	2 Ni, 1 Mn, .8 Si, 3.0 C, Fe	Recommended	
	18 Cr, .1 C, Fe 14 Cr, Fe	>240	1
	18.9 Cr, 7.3 Ni, 1.33 C, .5 Mn 18 Cr, 8 Ni, .06 C	>240	
	18 Cr, 1 Ni, 9 Mn, 1.6 C 18 Cr, 8.5 Mn steel	>240	1
	Nickel	<2.4 at 500° C.	1
	25 Cr, 60 Ni, 3 Mn, 2 Mo, 9 Fe	Strong attack at 360° C.	1
	Columbium	Dissolved	1
	Tantalum	Strong attack	1
	Silver	No attack if 0_2 free	1
	Gold	No attack if 0_2 free	1
	Platinum	Attacked	1
	20 Cr, 7 Ni	84 at 350° C. 890 at 600° C.	1
	18 Cr, 8 Ni, .10 C	84 at 360° C. 910 at 600° C.	
Potassium Iodide 680° C.	Silver	Strong attack	1
Potassium Nitrate 337° C.	Iron (See Table III)	No attack	1
	15 Cr, .2 % C, Fe 13.6 Cr, .34 C, 34 Mn	>240 at 550° C.	1
	18 Cr, .1 C, Fe 17-18 Cr, <0.1 C, Fe	<2.4 at 550° C.	1
	18 Cr, .1 C, 1.8 Mo 17 Cr, .4 C, 1.2 Mo	<2.4 at 550° C.	1
	Silver	Attacked	1
	Gold	Resistant	1
	Platinum	Attacked	1
Potassium Oxide	Iron	Not recommended	1
	Silver	Not recommended	1
	Gold	Not recommended	1
	Platinum	Not recommended	1
Potassium rhodanide 174° C.	Platinum	Attacked	1
Potassium sulfate 588° C.	Silver	Attacked	1
	Gold	Resistant	1
	Platinum	Attacked	1
Potassium sulfide 471° C.	Gold	Strong attack	1

Rosin	Stainless steel 302, 442	.004 IPY	2, 20
	Stainless steel 316, 302	less than .00035 IPM	4, 20
	Stainless steel 430, 410	less than .00035 IPM	4, 20
	Cast iron @ 700° F.	0.58 IPY	19
	Ni resist @ 700° F.	0.01 IPY	19
Silver chloride 455° C.	Nickel	Not recommended	28
Silver nitrate 208° C.	18 Cr, .1 C, Fe	>240 at 250° C.	1
	14 Cr, Fe	>240 at 250° C.	
	18 Cr, .1 C, 1.8 Mo	<2.4 at 250° C.	
	17 Cr, .4 C, 1.8 Mo, Fe	<2.4	
	18.9 Cr, 7.3 Ni, 1.33 C, .5 Mn, Fe	<2.4	
	18 Cr, 8 Ni, .06 C, Fe	<2.4	
	18 Cr, 10 Ni, .06 C, Fe	<2.4	
	18 Cr, 1 Ni, 9 Mn, Fe	240 at 250° C.	1
	18 Cr, 8.5 Mn, Fe	240 at 250° C.	1
	Nickel	Not recommended	1
Sodium bicarbonate 270° C.	Silver	Not recommended	1
Sodium bisulfate 7315° C.	18 Si, Fe; 14 Si, Fe	Recommended at 200° C.	1
	Silver	Strong attack	1
Sodium Borate 741° C.	18 Cr, .1 C, Fe	<2.4	1
	14 Cr, Fe	<2.4	
	18 Cr, .1 C, 1.8 Mo, Fe	<2.4	
	17 Cr, .4 C, 1.2 Mo, Fe	<2.4	
	18.9 Cr, 7.3 Ni, 1.33 C, .42 Si, Fe	<2.4	
	18 Cr, 8 Ni, .06 C, Fe	<2.4	
	18 Cr, 10 Ni, .06 C, Fe	<2.4	
	18 Cr, 8 Ni, <.07 C, 1 Mo, Fe	<2.4	
	18 Cr, 1 Ni, 9 Mn, .16 C, Fe	<2.4	
	18 Cr, 8.5 Mn, Fe	<2.4	
	18 Cr, 90 Ni	Recommended	1
	Cr—Ni (Chronin 85)	Recommended	
	Tantalum	Not recommended	1
	Silver	Attacked	1
Sodium carbonate 853° C.	Aluminum	Not recommended	1
	Iron—in air	2400 at 850° C.	1
	in nitrogen	1130 at 850° C.	1
	in hydrogen	12 at 850° C.	1
	18 Si, Fe	Not recommended at 900° C.	
	14 Si, Fe	Not recommended at 900° C.	
	18 Cr, .1 C, Fe	>240 at 900° C.	1

Sodium carbonate 853°C.	14 Cr, Fe	>240 at 900° C.	1
	18 Cr, .1 C, 1.8 Mo, Fe	>240 at 900° C.	1
	17 Cr, .4 C, 1.2 Mo, Fe	>240 at 900° C.	1
	18.9 Cr, 7.3 Ni, 1.33 C, .42 Si, Fe	>240 at 900° C.	1
	18 Cr, 8 Ni, .06 C, Fe	>240 at 900° C.	1
	Stainless steel 302 316	>.42 IPY at 1650°F.	1
	18 Cr, 10 Ni, .06 C, Fe	>240 at 900° C.	1
	18 Cr, 8 Ni, <.07 C, 1 Mo, Fe	>240 at 900° C.	1
	18 Cr, 1 Ni, 9 Mn, .16 C, Fe	>240 at 900° C.	1
	18 Cr, 8.5 Mn, Fe	>240 at 900° C.	1
	Nickel	<2.4 at 900° C.	1
	Monel	Recommended	
	Columbium	Strong attack	1
	Tantalum	Strong attack	1
	Gold	Strong attack	1
	Platinum	Strong attack	1
	Silver at 930° F.	Attacked	2
	Stainless steel 302	.42 IPY at 1650° F.	2
Sodium chloride 800° C. See Table III	34 Cr, 2 C, Fe	>240 at 900° C.	1
	28 Cr, 1 C, Fe	>240 at 900° C.	
	32 Cr, Mo, Fe	>240 at 900° C.	1
	28 Cr, 1 Co, 2 Mo	>240 at 900° C.	1
	.6% C steel (for 5 hrs.)	1520 at 850° C.	1
	(for 26 hrs.)	554 at 850° C.	1
	Cast steel (for 5 hrs. experiment)	2630 at 850° C.	1
	(for 26 hrs.)	1170 at 850° C.	1
	Copper steel (5 hrs.)	2710 at 850° C.	1
	(26 hrs.)	815 at 850° C.	
	Chromium steel (5 hrs.)	471 at 850° C.	1
	(26 hrs.)	152 at 850° C.	1
	Copper	Strong attack	1
	Silver	Strong attack	1
	Platinum	None too little attack	1
Sodium cyanide 563.7° C.	Iron — carbon pick up	Little attack	1
	Chrome plate	Resistant	24
	Monel	Not recommended	1
	Nickel	Not recommended	28
	Silver	Not recommended	1
Sodium fluoride 992° C.	Iron — in air	3600	1
	in $C0_2$	1440	1
	in nitrogen	720	1
	in hydrogen	24	1
Sodium hydroxide 318° C.	Cast iron — note reference		7
	Cast iron	0.84 IPY @ 1240° F.	19
	Cr cast iron	Strongly attacked at 300° C.	1

Sodium hydroxide 318°C.	**14 Ni, 6 Cr, 5 Cu, 1-1.5 Mn, 1.2-2 Si, 2.7-3. C, Fe**	**Recommended**	**1**
	18 Cr, .1 C, Fe	**>240**	**1**
	14 Cr, Fe	**>240**	
	18 Cr, .1C, 1.8 Mo, Fe	**>240**	
	17 Cr, .4 C, 1.2 Mo, Fe	**>240**	
	18.9 Cr, 7.3 Ni, 1.33 C, .42 Si, Fe	**<24**	**1**
	18.9 Cr, 7.3 Ni, 1.33 C,.42 Si, Fe	**<24**	
	18 Cr, 10 Ni, .06 C, Fe	**<24**	
	18 Cr, 8 Ni, .07 C, 1 Mo, Fe	**<24**	
	18 Cr, 1 Ni, 9 Mn, .16 C, Fe	**>240**	**1**
	18 Cr, 8.5 Mn, Fe	**>240**	**1**
	15 Cr, .1C, Fe	**Attacked at 540° C.**	**1**
	13 Cr, .1C, Fe	**Attacked at 540° C.**	
	Stainless steel —at high temperature & high pressure	**Pitting**	**6**
	Nickel	**<2.4 at 500° C.**	**1**
	Ni anode at 900° F.	**.0113 IPY**	**21**
	Ni cathode at 900° F.	**.0009 IPY**	**22**
	Ni uncoupled at 900° F.	**.0112 IPY**	**21**
	Niresist at 1240° F.	**0.26 IPY**	**19**
	Monel	**Recommended**	**1**
	80 Ni, 14-20 Cr, Fe	**<2.2 at 318° C.**	**19**
	60 Ni, 15 Cr, Fe	**<2.2 at 318° C.**	
	Columbium	**Dissolved**	**1**
	Tantalum	**Not recommended**	**1**
	Zinc	**Not recommended**	**1**
	Silver	**Usable to 550° C.**	**1**
		Strong attack at 710° C.	**1**
		.001 IPY at 900° F.	**2**
	Stainless 316, 302	**.0042 — .042 IPY at 600° F.**	**2**
	Fe-Ni-Cu-Cr (13-15, 5.5-7.) Niresist	**.25 IPY**	**2**
	Ni-Cr-steel (80; 14–20) (60; 15)	**<.004 IPY at 604° F.**	**2**
	Pure silver	**17.4 at 400° C.**	**1**
	Fine grained silver	**14.5 at 400° C.**	**1**
	Gold (and 0_2)	**Often usable**	**1**
	Platinum (0_2 free)	**No attack below 400° C.**	**1**
Sodium metaphosphate 616° C.	**Silver and 0_2**	**Not recommended**	**1**
Sodium nitrate 310° C.	**See Table III**		
	Aluminum	**No attack**	**1**
	Armco iron	**Recommended**	**1**
	15 Cr, .2 C, Fe	**>240**	**1**
	14 Cr, Fe	**>240**	
	18 Cr, .1 C, Fe	**<2.4**	**1**
	17-19 Cr, <.1 C, Fe	**<2.4**	
	17 Cr, .12 C, Mo, Fe	**Recommended**	**1**
	Stainless steel 302	**.00035 — .0035 IPM**	**20**
	316	**less than .00035 IPM**	**20**
	430	**.00035 — .0035 IPM**	**20**
	Stainless steel 430	**.042 — 12 IPY**	**2**
	18 Cr, .1 C, 1.8 Mo, Fe	**<2.4**	**1**
	17 Cr, .4 C, 1.2 Mo	**<2.4**	**1**
	18.9 Cr, 7.3 Ni, 1.33 C, .5 Mn	**<2.4**	**1**

Sodium Nitrate 310° C.	18 Cr, 8 Ni, .06 C	<2.4	1
	18 Cr, 10 Ni, .06 C	<2.4	1
	18 Cr, 8 Ni, <.07 C, 1 Mo	<2.4	1
	Stainless steel 316	.0042 IPY	2
	18 Cr, 1 Ni, 9 Mn, .16 C	<2.4	1
	Stainless steel 302	.0042 — .042 IPY	2
	~18 Cr, ~8.5 Mn	<2.4	1
	18 Cr, 8 Ni, .10 C, Fe	Recommended at 550° C.	1
	Nickel	<2.4 at >310° C.	1
	Tantalum	Strong attack	1
	Silver	Not recommended	1
	Gold	Little attack	1
	Platinum	Little to strong attack	1
Sodium oxide 460° C.	Gold	Not recommended	1
	Platinum	Not recommended	
Sodium phosphate	Nickel	Not recommended	1
	Silver	Not recommended	1
Sodium silico Fluoride			
	Iron — in air	5030	1
	— in CO_2	960	1
	— in N_2	2155	1
	— in H_2	0.0	
	— in N_2 & 5% H_2	2.4	1
	Gold	Not recommended	1
Sodium sulfate 884° C.	Aluminum	Strong attack at red heat (explosive)	1
	Nickel	<2.4	1
	Silver	Strong attack	1
	Gold	Resistant	1
	Platinum	Attacked	1
Sodium sulfide 275° C.	Tantalum	Strong attack	1
	Silver	Strong attack	2
	Gold	Not recommended	1
	Platinum	Not recommended	1
Succinic acid 190° C.	Stainless 302	Attacked .120 — 0.420 IPY	5
Zinc Chloride 365° C.	Cast iron	Little attack	1

TABLE III

CORROSION OF MATERIALS IN SALT MIXTURES

SALT mixtures are used extensively as heat transfer media, or to change the surface chemistry, particularly that of steel. Even less data on corrosion by molten salt mixtures is available in the literature.

* * *

IN this table the material of construction is the heading, while the mixtures are informally discussed below.

* * *

ARMCO iron was most resistant to nitrates and nitrites and their mixtures. On long standing nitrides believed found on steel (13) alkali chlorides stimulated corrosion (14) and rate of increase of alkalinity of molten salts was an index of the rapidity with which corrosion took place (8).

* * *

REFER also to "Alloy pots for Liquid Heat Treating' media" (17), where salt mixtures with trade mark are listed.

Metal	Molten Salt Mixture		Reference
Aluminum	$NaNO_3$, $NaNO_2$, KNO_2, KNO_3, and their mixtures below 1000° F.	No attack	1
	48% $CaCl_2$, 31% $BaCl_2$, 21 NaCl	480 g/m²/day at 530° C.	9
	40 KCl-60 LiCl	710 g/m²/day at 380° C.	9
	40% KCl, 60 LiCl & 6% Na_2CO_3	145 g/m²/day at 530° C.	9
	KCl (25–45) NaCl (15-25) $CaCl_2$ (10-50) $SrCl_2$ (5-20)	235 g/m²/day at 510° C.	9
	The above & $BaCO_3$ (1-25)	No attack on Bondur alloy (4.5% Cu, Si, Mn, Mg, Al)	9
	Na_2CO_3, 60 NaCN–40Na_2CO_3	4g/m²/day at 930° F.	
Copper	Plate attacked by carburizing bath type used up to 1650° F.	110 g/m²/day	11
	Low cyanide (max 12% NaCN) high temperature up to 1850° F.	Little attack	
Iron or Steel	75$Na_2Cr_2O_7$–25$K_2Cr_2O_7$ at 500° C.	30-35 g/m²/day	10
	Above mixture & 10% K_2CrO_4	2–3 g/m²/day	
	pressed steel pots used for low temperature (up to 1650° F) high cyanide (to 30% NaCU) carburizing baths.		
	Cr–Ni steel: 75 $Na_2Cr_2O_7$-25$K_2Cr_2O_7$ at 500° C.	7-8 g/m²/day	10
	Above & 10% K_2CrO_4	.7-.8 g/m²/day	
	60 Ni-12 Cr pots for holding NaCl-KCl eutectic	Recommended	12
	35 Ni-12 Cr pots for holding NaCl–KCl eutectic	Recommended	12
	28 Cr-Fe for Ba Cl_2-NaCl-KCl eutectic mixtures	Recommended	12
	Pressed steel, welded steel, calorized steel & cast steel.	Recommended up to 1650° F. in $BaCl_2$, $CaCl_2$ KCl, NaCl and Na_2CO_3 mixtures.	18
	Pressed steel, welded steel, calorized steel & cast steel.	In quench type bath (NaCN, KCl, Na_2CO_3 K_2CO_3) Recommended.	
	Pressed steel, welded steel, and cast steel.	Recommended for NaCN, $BaCl_2$, Na_2CO_3 mixture.	

Nickel	75% $Na_2Cr_2O_7$ 25 $K_2Cr_2O_7$ at 500 C	6–7 g/m²/day	10
	Above mixture & 10% K_2CrO_4	.6-.7 g/m²/day	
	NaCl-KCl eutectic mixtures	Recommended	
	"L" Ni, & "L" Ni clad steel for nitrates, nitrites & mixtures	Recommended	3
	Inconel clad steel, Ni-resist, 35:15 Ni-Cr alloy, and 60:16 Ni-Cr alloy — for cyanide containing salt mixtures and also for baths containing various mixtures of 2 or more of NaCl, KCl, $BaCl_2$, $CaCl_2$, Na_2CO_3 and K_2CO_3	Recommended	3
	37 Ni-12% Cr alloy	Tempering salts — good High speed salts — medium Neutral salts — poor Cyanide & carburizing salt — very good.	23
	25% Cr–12 Ni alloy	Tempering salts — medium High speed salts — poor Neutral salts — poor Cyanide & carburizing salts — good.	23
	35% Ni-15% Cr cast	Recommended for sodium cyanide Recommended for carburizing in $BaCl_2$ & sodium cyanide. Not recommended for $BaCl_2$ — $CaCl_2$ — NaCl mixture. Recommended for nitrate — nitrate mixtures.	18 18
	60% Ni-12% Cr alloy See also reference 26.	As above.	18

Corrosion of various materials in 40% $NaNo_2$ — 7% $NaNO_3$ — 53% KNO_3 — 25

Salt mixtures at various temperatures	850° F	1000° F & 1100° F
	Penetration in inches per month	
Open hearth steel	.0003	.001-.002 .01-.05
15-16 Cr — iron		.0000
18:8-1% Co		.0000
18:8-2-4 Mo (KA2SMo)		.0000
Alcrosil No. 3 (3% Cr, .5% Al, 1% Si, .5 Mo)	.0002	.001 .002-.006
Alcrosil No. 5 (5% Cr)	.0002	.0005 .001-.002
Copper		.3
Monel		.0001
Inconel		.000

Magnesite brick used for carburizing baths.

Ceramic bricks used for carburizing baths and salt mixtures used as thermal transfer media in the heat treatment of steel.

TO WIRE MILL MEN

Have you considered joining the Wire Association? You are cordially invited to become a member. Dues are $15.00 *a year, which includes a subscription to WIRE & WIRE PRODUCTS and a copy of the Annual Buyers Guide.*

THE WIRE ASSOCIATION

300 MAIN STREET STAMFORD, CONN.

J & L Modernizes Wire Mill

AN intensive modernization of wire producing facilities at the Aliquippa Works of Jones & Laughlin Steel Corporation, amounting to more than $2,000,000. in expansions and improvements, is nearing completion.

* * *

NEARLY every phase of wire production has been augmented with latest model equipment and additional facilities effecting an appreciable increase in capacity and considerably improving the quality of wire products — a striking example of the program now underway in departments throughout the corporation.

* * *

AS these products include a wide variety of manufacturer's wire for further finishing by fabricators, and merchant wire in the form of finished products, nearly all processes in wire production are involved.

* * *

ADDITIONS and improvements to-date include:

(1) A program for installation of 55 latest model wire drawing machines is nearing completion.

(2) A new straight line rod cleaning unit has been placed in operation.

(3) Two bright wire annealing furnace installations are completed.

(4) An additional patent annealing furnace with lead quench has been installed.

(5) A new electric oil tempering unit is being added.

(6) Fourteen new nail machines—the first part of a program for the installation of 120 machines—have started production.

(7) New nail blueing facilities are planned.

(8) A program for palletization of the nail mill is in progress.

(9) Several additional major improvements are in the blue-print stage, and are under consideration.

* * *

Wire Drawing Machines

THE last two machines in a total of 55 latest model continuous water and air cooled wire drawing machines are being installed. These machines have improved both the

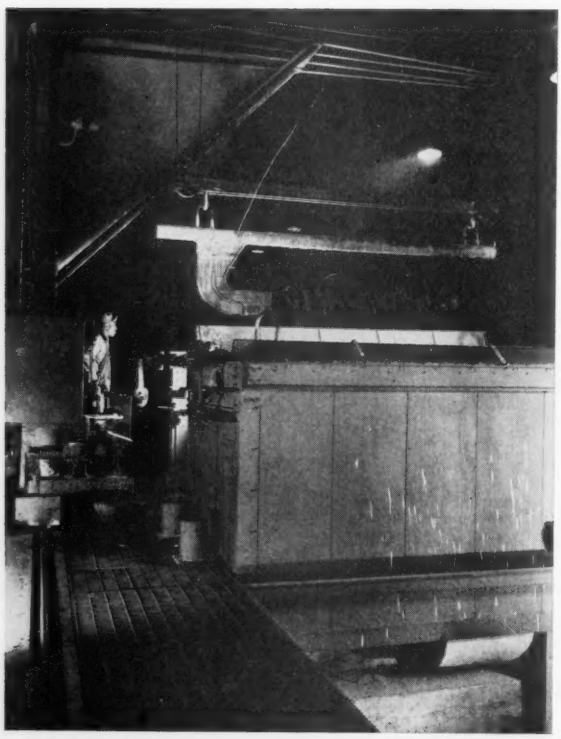

Fig. 1. — FLASH BAKING UNITS IN WIRE MILL

Coils of lime coated rods, are shown here being lifted from flash baking units at the delivery end of the new cleaning and lime coating installation recently placed in operation in the wire mill of Aliquippa Works, Jones & Laughlin Steel Corporation.

Heated by by-product gas, the baking ovens maintain approximately 500 degrees fahrenheit temperature, baking the lime coating on the coiled rods in about ten minutes. The loads of coiled rods carried on "Hairpin hooks", are conveyed from one unit to the next in this line by Gantry cranes. The rated capacity of the entire unit is approximately 200 tons per eight hour turn.

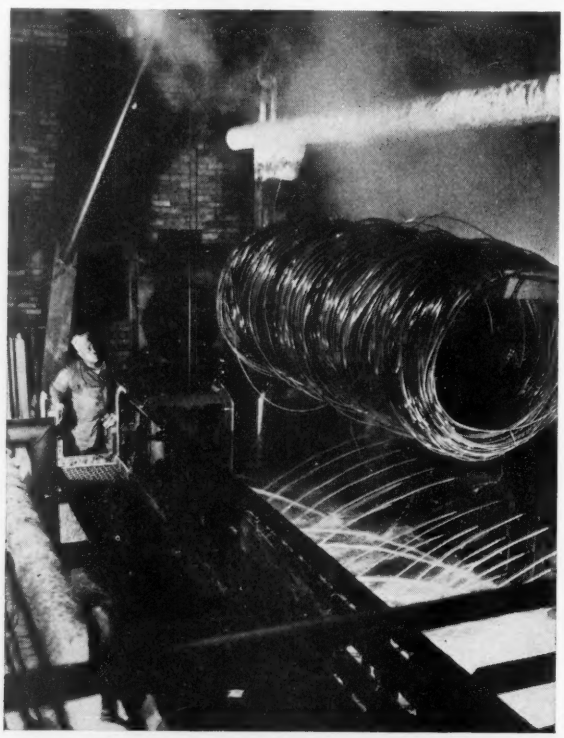

Fig. 2. — CLEANING COILS OF RODS

The new cleaning and lime coating unit at the Aliquippa Works, Jones & Laughlin Steel Corporation, is one of the most modern installations in the industry for preparing steel rods to be drawn into wire.

The cleaning units consist of five pickle vats and a rinse tank shown in operation above), which remove scale from the rods. Each pickle vat has 7,000 gallon capacity for cleaning chemicals, in which three pins, of 3,000 pounds each, of rods are immersed in one charge. In the rinse tanks water is sprayed on the coils at 250 lbs. per square inch pressure — using 500 gallons of water per minute.

From this tank, the coils of rods will be processed through two lime coating vats, each with 2,500 gallon capacity, and four flash baking units.

speed of production and the quality of the wire produced.

* * *

GROUPED according to the number of die holes, machines with three to four holes and up to 16 holes are included. On the 16 hole machines, the latest model to be installed, 16 gauge wire is drawn down to .0065 wire at high speed.

* * *

New Cleaning Unit

AMONG the newest installations in operation is a straight line rod cleaning unit consisting of an entry end rack, five pickling tanks, a rinse tank, a transfer rack, two lime coating tanks, and two special solution tanks, four flash baking units and a delivery rack.

* * *

TWO Gantry cranes, one operating at the entry end and one at the delivery are employed to move the hooks from unit to unit. Coils of rods arrive at the entry end of the unit in 3,000 lb. bundles which are loaded on hairpin hooks. The crane lifts the "pins", as the loaded hooks are termed, from one process to the next. The rated capacity of this cleaning unit is approximately 220 tons of coiled rods per eight hour turn.

Fig. 3. — NEW PATENT ANNEALING FURNACE
High carbon rods or wire for processing manufacture into spring-wire to be used in the manufacture of upholstery or bed springs, are heat treated in the new patenting furnace recently placed in operation at the Aliquippa Works, Jones & Laughlin Steel Corp.
From the feed reels in the foreground, 36 rods are fed simultaneously into the furnace, in a continuous operation. Approximately 9,000 lbs. of rods or wire are treated hourly.
The furnace is capable of maintaining temperature up to approximately 2,000 degrees Fahrenheit. Either gas or oil fuel provides the heat, the furnace being calibrated for both.
The feed reels are double deckers for the convenience of the reelers.

Bright Wire Annealing

A new installation for controlled bright annealing of wire or rod coils, consisting of an eight base unit with two furnaces, and a six base

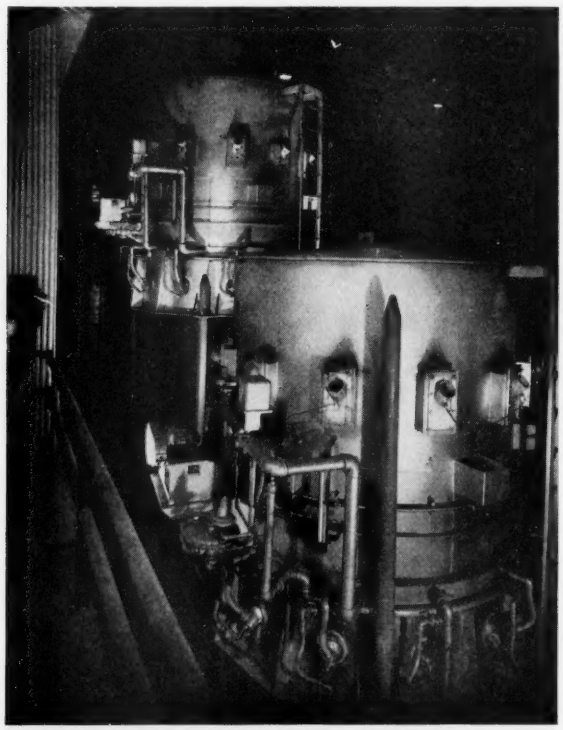

Fig. 4. — NEW WIRE ANNEALING FURNACES
This new installation for controlled annealing of wire coils at the Aliquippa Works, Jones & Laughlin Steel Corporation, has improved the quality of annealing.
Shown in the foreground is a Bell-type furnace in position, as another furnace is being lifted from a covered stack of wire coils. The stack being uncovered has been heated uniformly to a temperature of 1400 degrees fahrenheit and has been maintained at that heat for a period of time suitable to the required physical properties of the wire.
Inside the cover, the wire coils have been protected by an atmospheric gas. The installation is one part of J&L's program for improvement and expansion of its wire producing facilities. * *

Fig. 5. — NEW NAIL MACHINES
Part of a battery of new nail machines recently installed at the Aliquippa Works, Jones & Laughlin Steel Corporation; the machine in the foreground can produce 400 nails per minute — approximately the cyclic rate of fire of a .30 caliber machine gun. These machines have an increase of 25 per cent in productive capacity over old style machines, and a 15 per cent increase in efficiency. * * * * *

unit with two furnaces, recently was placed in operation.

* * *

STACKS of wire coils on the bases are covered, and heated uniformly to a temperature of 1400 degrees Fahrenheit by Bell type furnaces, which are lifted and lowered into position by an overhead crane.

* * *

WIRE coils, inside the cover are protected by an atmospheric gas, and are maintained at the necessary heat for a period of time suitable to the desired physical properties of the material.

* * *

Patent Annealing Furnace

THE new patent annealing furnace and lead quench, is the fourth such installation in the wire mill, and includes latest improvements for gas and oil firing. Plans are ready for a fifth furnace.

* * *

THIRTY-SIX high carbon rods or wire, are fed simultaneously into the new furnace, which has a capacity of 9,000 lbs. of rods or wire hourly, and lead quenched in a continuous operation. The furnace maintains a temperature of 2,000 degrees Fahrenheit, heated either by gas or oil at the turn of a valve.

Electric Oil Tempering Unit

A new electric oil tempering unit is being installed in addition to the two now in operation. This unit is novel in that heat for treating the material is provided through the use of electric current passing through wire strands — just as electric current heats the coils in an electric toaster. The strands pass through a contact pan containing molten lead, and feed into a second contact pan containing an alloy with quench oil on top.

* * *

EITHER rods or wire are heat treated, and sometimes an order is heat treated both prior to wire drawing and after drawing, depending upon the physical characteristics.

* * *

Galvanizing Unit

ONE new 36 strand **Herman** process galvanizing frame has been added to the one already in operation. In addition, facilities include an asbestos wipe process which is 36 strand and a 20 strand unit for galvanizing fine wire which is either air cooled or asbestos white, convertible to tin coating, which finishes the wire either on spools or in coils.

THE Herman process consists of a rigid, vibration-free machine, with complete mechanical adjustments, for applying the purest zinc obtainable in a bath. As the wire emerges, excess spelter can drain freely, and the coating solidifies in a non-oxidizing atmosphere while water is applied to enhance the natural luster of the zinc.

* * *

SUCH wire is readily drawn to diameters corresponding to 95 per cent reduction in area, with speeds in some of the finer sizes regularly hitting the 2,000 foot per minute mark. Wrap tests made regularly show no surface peeling, but rather a hard, dense surface of comparatively high luster.

* * *

New Nail Machine

FOURTEEN new nail machines have been added to the nail producing facilities, and the installation of 30 more is now in progress—part of a program to install 120 latest model machines.

* * *

THESE machines pound out 400 nails per minute — approximately the cyclic rate of fire of a .30 caliber machine gun. Output per machine has been increased 25 per cent over old style machines and efficiency has been increased by

(*Please turn to page* 623)

Fig. 6. — WIRE DRAWING MACHINES
Latest model wire drawing equipment at Jones & Laughlin Steel Corporation's Aliquippa Works have improved both the speed of production and the quality of the wire produced.
On this machine wire is drawn through seven dies simultaneously, at a delivery speed of approximately 1,200 feet per minute —finishing .037" dia. wire at nearly 15 miles per hour. The size of the wire is reduced by 30 per cent by each die. One 300 lb. coil of rods is drawn out in about 45 minutes to a length of more than 13 miles on the machine equipped with a continuous water cooling system. * * * * * *

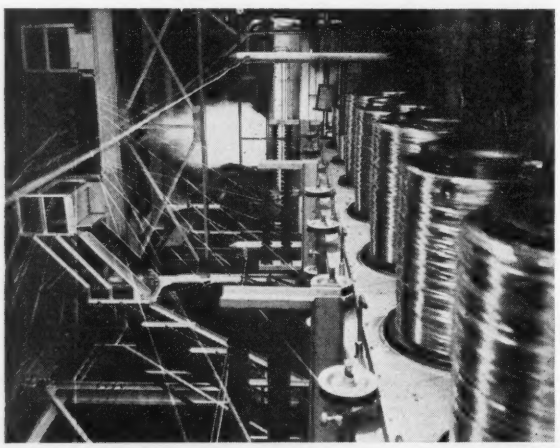

Fig. 7. — NEW WIRE GALVANIZING UNIT
This new wire galvanizing unit is part of the expansion by Jones & Laughlin Steel Corporation of Wire Mill heat treating, cleaning and finishing facilities at the Aliquippa Works. * * *

Spring Design and Manufacture

PART II

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(Published in Two Parts)

Part I was published in the June, 1948 Issue of Wire & Wire Products.

Volute Springs

LET us first consider Volute Springs.

* * *

IN a volute spring the slope of the developed coil is constant, while the outline of the spring is in the form of a paraboloid and its profile is in the form of a parabola.

* * *

ONE additional feature to make this a true volute spring is that the radial spacing be at least equal to the thickness of the blade, so that, under maximum load, all coils nest inside each other.

* * *

IN all applications the coiling is not carried through to the apex of the enveloping paraboloid. Consequently the outline is a truncated paraboloid.

* * *

WHEN loaded the larger diameter coils deflect first causing bottoming which results in the coils which have been bottomed becoming inoperative.

* * *

THE **"bottoming"** of any point has reached the limit of its potential deflection and now becomes part of the inactive end coils.

* * *

THIS potential deflection of point "x" we will call "hx" because it is the height of point "x" from the bottom surface minus the solid height of the coils up to point "x". The maximum deflection of the entire spring we will call "h".

* * *

IN a volute spring, deflection is proportional to the developed length of the coils namely:—

$$\frac{h_x}{h} = \frac{L_x}{L}$$

WHEN the spring is deflected solid the profile will assume what we will call the "solid slope". This solid slope will be zero for a volute spring since all coils are nested within each other.

* * *

WHEN point "x" is bottomed the profile at this point is at right angles to the axis of the spring.

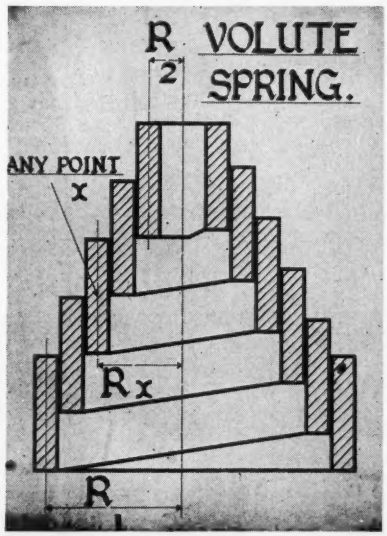


Figure 2.

* * * * *

THE initial part of the deflection is at constant rate. When deflection has proceeded far enough for the first active element to become bottomed and thus rendered inactive the process of reducing the number of active coils begins with a transition from the original spring rate to higher and higher rates.

* * *

THE load at which this transition process begins we will call the transitional load.

THE profile line is a straight line under no load, but is deformed under load so that gradual merging with the solid slope takes place.

* * *

NORMALLY this merging will start at the largest active coil radius R_1 and end at the smallest active coil radius R_2 (Figure 2).

* * *

THESE explanations are preliminary to considering the load which we will call Px which will cause bottoming at any point "x" with a coil radius Rx.

This load Px is inversely proportional to:—

$$Rx \quad (R_1 + R_2)$$

* * *

THE load Px is greater than the transitional load and the deflection which we will call fx is made up of two components — one component $f'x$ indicates the deflection in the coils which bottomed (between R_1 and R_2). The other component $f''x$ denotes the deflection in the coils which still remain active (between Rx and R_2).

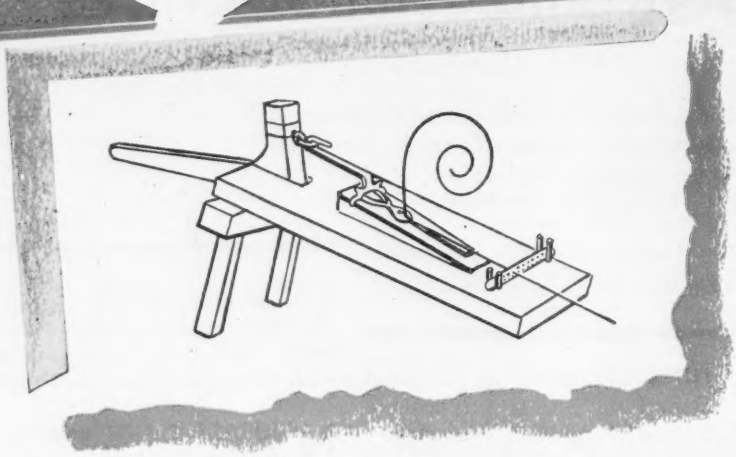
* * *

ALL coil springs are subject to torsion stress under compression loads, but before we consider the torsion stress in a coiled bar it would be well to examine the torsion stress in a straight bar.

* * *

THE straight rectangular bar, according to **De Saint Venant's** theory, has a maximum stress which is concentrated at the middle of the longer surfaces of the rectangle. It is dependent upon this longer surface, upon the square of the shorter surface, and upon the stress factor ($_7{}^2$). This stress factor is dependent on the ratio breadth over thickness.

Which die . . .



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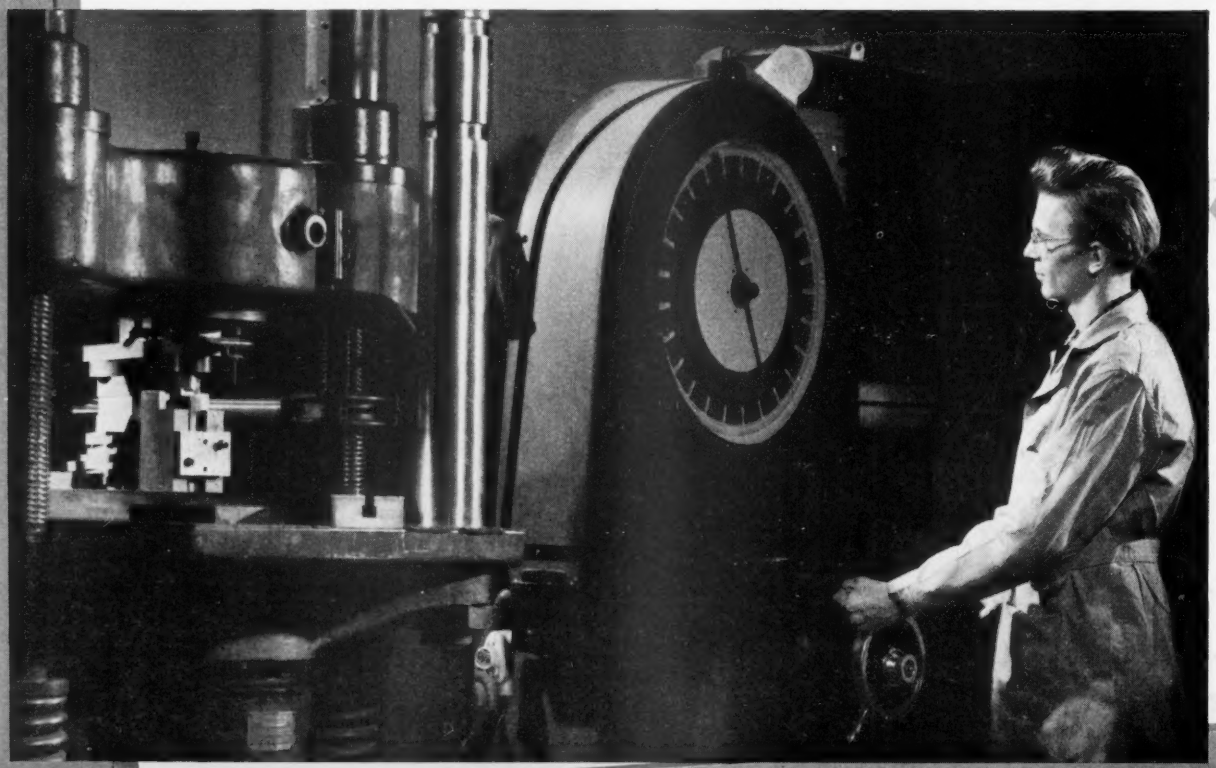

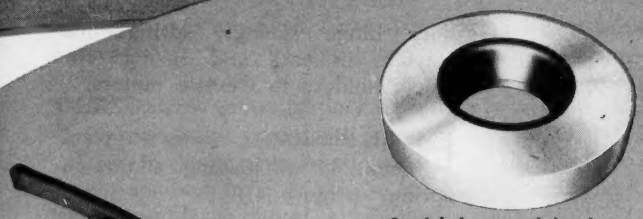

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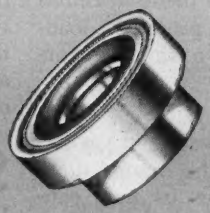

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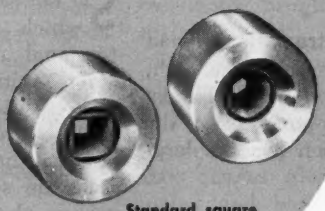

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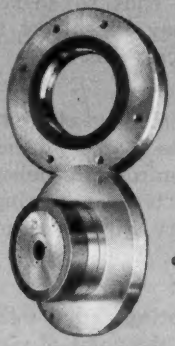

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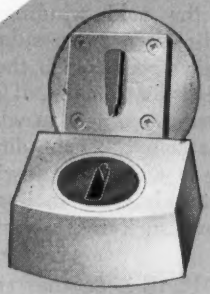

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WHEN the bar is coiled, a further stress concentration takes place at the point nearest the axis of coiling, due to the effects of curvature.

* * *

THE formula described earlier in this talk for this stress concentration factor is used again, i.e., the **Wahl** factor.

* * *

THE maximum stress at the middle of the longer surface which is nearer to the axis of coiling must be multiplied by the stress concentration factor.

* * *

SO far we have considered the **stress distribution within the cross section of the blade.**

* * *

THE **stress variation throughout the length of the blade** is related to the gradual bottoming of the coils.

* * *

AS long as the transitional load has not been reached, the highest stress is always in the largest active coil or to be more exact, the spring element which has the largest coil radius.

* * *

WHEN the load exceeds the transitional load and becomes Px the maximum stress in the spring still occurs at the largest active coil radius and that is now the coil radius Rx for which Px is the bottoming load.

* * *

THE maximum stress within the cross section is inversely proportional to the coil radius because the stress is proportional to PRx, and P itself is inversely proportional to $R \frac{3}{x}$.

* * *

THUS the stresses are generally higher in the smaller coils; this is accentuated by a secondary cause inasmuch as the stress concentration factor also increases as the coil radius decreases.

* * *

A **volute** spring has a constant rate until the load is reached which immediately causes the spring rate to increase.

* * *

SO instead of producing a load-deflection graph which is linear

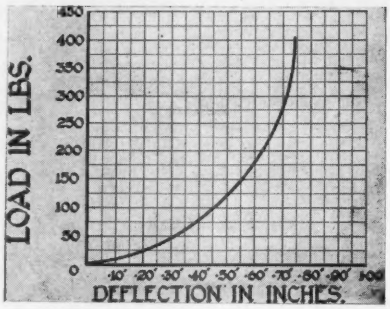

Figure 3. * * * * *

one obtains a load-deflection curve similar to this. (Illustration). (Figure 3.)

* * *

CONICAL springs made in round section material produce a load-deflection graph of a similar character.

* * *

SO far we have considered springs which subject the material to torsional stresses, let us now consider springs which, although they are essentially the same shape as helical compression or tension springs, have the ends so shaped that the spring may be subject to torque about the coil axis.

* * *

BECAUSE of the mode of stressing such springs the primary stress is flexural, in contrast to helical compression or tension springs where the primary stress is torsional.

* * *

THE design of spring end is made primarily from the point of view of transmitting external torque to the spring.

* * *

Torsion Springs

TORSION springs are used in a wide variety of applications among which may be mentioned

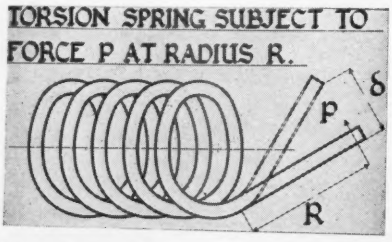

Figure 4. * * * * *

door hinge springs, springs for starters in cars and springs for brush holders in electric motors.

* * *

HERE illustration shows a typical method of loading a torsion spring. (Figure 4).

* * *

HERE the spring is supposed to be wound round a rod, one end being fastened to the rod while the other rod has a straight portion projecting outward.

* * *

IF this arm is loaded by a force P at a radius R from the axis in such a manner as to wind the spring, the moment tending to twist the spring will be PR as indicated in the illustration. Because of friction between the spring and the guide, the actual moment may decrease along the spring so that an exact calculation becomes involved.

* * *

SINCE most torsion springs are wound cold, it is advisable to load them in such a way that the spring tends to wind up as the load is applied.

* * *

THE reason for this is that residual stresses set up in consequence of the cold winding are in such a direction as to subtract from the peak stress due to the loading, provided that the load is in the same direction as that in which the spring was wound. If the direction of loading is such as to unwind the spring, it is advisable to heat treat to remove such residual stresses.

* * *

THERE is another reason for loading the spring in this manner. Referring to the illustration again, for a loading tending to wind up the spring, the reaction will be against the arbor and the peak bending moment in the spring will be PR. However, if the load is in the opposite direction to that shown, the peak moment will be p(R + r) where r is the mean coil radius. This means a considerable increase in stress, particularly if r is about as large as R.

* * *

End Conditions

FOR many cases where the ends of the spring are clamped, or

if special ends are used, some stress concentration may be expected.

* * *

THESE stress concentrations should be carefully considered, particularly if the spring is subject to fatigue loading, or if it is to be subject to a large number of load repetitions during its life. On the other hand, if the number of load applications is small during the spring life, such stress concentrations may probably be neglected.

* * *

BECAUSE a **torsion** spring (for usual applications) tends to wind up with load, its diameter decreases. In design, it is important that sufficient clearance be allowed between the arbor or rod, about which the spring is wound, and the inner diameter of the spring. If this is not done, the spring may bind or wrap around the arbor and high stresses may be set up.

* * *

THE clearance may be calculated from the deflection of the ends. Thus, if the spring end deflects 90° or a quarter of a turn and the spring has eight turns, the diameter will change in the ratio of ¼ to 8 or about 3%. This can be allowed for in design.

* * *

IF the spring fits inside a tube and is loaded so as to unwind, sufficient clearance must be allowed between the outside diameter of the spring and the inside diameter of the tube. This clearance may be estimated in the same manner as before.

* * *

SOMETIMES quite long torsion springs are used. Where this is done, there is always the possibility of torsion buckling. This may be avoided by providing such springs with guides, such as rods or tubes. By properly clamping the ends or by applying an initial tension load, it is possible to avoid buckling in some cases without the use of guides.

* * *

USUALLY for manufacturing reasons, **torsion springs** are made of **round wire.** However, where maximum energy storage is required in a given space, the use of **square** or **rectangular wire** may be avisable. The reason for this, is that in bending, the square or rectangular section has a large proportion of material subjected to stresses near the peak value than is the case for circular wire. Consequently, for the same peak stress, greater energy storage may be obtained for a given volume of material for square or rectangular wire than for circular wire. Also, for a given spring index, more material may be compressed within a given outside diameter in the case of rectangular wire; this further increases the amount of energy which may be stored in a given space.

* * *

Spiral Springs

ANOTHER type of torsion spring which has many advantages from the stand-point of energy storage within a limited space, is the spiral spring, consisting of flat strip material wound to form a spiral. In addition such springs are relatively simple to manufacture. Because of these advantages, spiral springs are widely used in clocks, watches, electrical instruments and similar devices. Other applications include brush holder springs for electric motors and gramophone motors.

* * *

IF the **spiral** spring is so wound that individual turns do not come in contact, the analysis for the spring may be carried out with considerable accuracy. Such an example is provided by the hair spring of a watch.

* * *

ON the other hand, if the turns of the spring are wound tightly together, as in the case of a gramophone motor spring, a different kind of analysis must be made because of the friction between the turns. These points must be carefully considered when commencing to design a spiral spring.

* * *

THE stress formula on all these types of springs is derived from the standard beam formula:—

$$\frac{My}{I}$$

Where:—

M = moment in inch lbs. i.e. PR

y = Distance from the neutral axis to the extreme fibre under consideration.

I = Moment of inertia.

* * *

IN these days the use of flexible mountings, such as spring suspension of car engines etc., is becoming more and more important.

* * *

Natural Frequency

AN understanding of natural frequency is very necessary for the study of flexible mountings.

* * *

THERE is a great deal of confusion about natural frequency because the term is used loosely to describe two entirely different characteristics.

* * *

TO clarify this term let us digress from the subject of flexible mountings for a while to describe in some detail the type of natural frequency usually associated with springs.

* * *

WITHOUT other definition, natural frequency would mean the frequency at which a disturbance passes along the coils of a spring and back to the free end. This phenomenon may be readily observed in a spring with a large index and a large number of coils.

* * *

IF such a spring is given a jerky movement, the impulse may be seen to travel through the coils successively as a wave, and if one end of the spring is fixed, the wave will be reflected back to the free end. If the spring is given several jerks, the waves will follow each other and the reflected waves will pass each other. This action is called "surge" and this phenomenon was mentioned earlier in this talk.

* * *

THE formula given earlier for the natural frequency i.e.

$$589\sqrt{\frac{R}{W}}$$

gives the frequency of the waves in a steel spring.

* * *

THE solution of this equation gives the frequency at which one wave travels the length of the spring and back again. If the spring operated

at this speed, that is, in resonance with its natural frequency, the forces generated would destroy the spring very quickly, even though the force of the blow was not very great. If the speed of operation was half as great as the natural frequency, the second harmonic of the natural frequency would be excited, and so on.

* * *

SO far it has been assumed that one end of the spring was fixed and a blow was applied at the other end. Now the other type of natural frequency of vibration, which will be referred to from now on, deals with a system consisting of one or more springs and their attached loads.

* * *

THIS characteristic can be visualized by thinking of a long extension spring, hanging from a hook with a weight attached to the lower end. Now, if the weight is pulled down a certain distance, then released, the weight will oscillate up and down at a certain speed.

* * *

THE damping effect of the air will cause the weight to travel a shorter distance with each cycle until the motion dies out, but the speed or frequency of vibration will remain constant. This may be compared to the action of a pendalum because it has a constant period, regardless of the distance it travels.

* * *

NOW, if a different weight were suspended from the spring, the natural frequency would be different. A heavier weight would cause a slower frequency, and a lighter weight would cause a higher frequency in the same spring. This is dependent upon the fact, that the heavier weight causes a greater static deflection. In other words, the natural period of vibration of a spring and its load, is governed by the static deflection of the spring. This relationship is expressed in the formula:—

$$\text{NATURAL FREQUENCY} = \frac{188}{\sqrt{\text{Static deflection}}}$$

FROM this formula it is apparent that any combination of springs and load which have the same deflection, will also have the same natural frequency of vibration. Also, the frequency may be decreased by designing the spring so that the given load causes a greater static deflection. It should also be noticed that the frequency might be decreased by increasing the static load on the same spring.

* * *

YOU will notice that I have mentioned decreasing the natural frequency of the spring mounting, and a familiar experience will illustrate the advantage of this.

* * *

A motor car carrying a load of four passengers, will ride smoother than it does when the driver is alone. This effect is much more noticeable in a five ton truck, because the difference in loading is a much greater percentage. When a five ton truck is empty, the springs are deflected only a small amount and the natural frequency of the system is high. Accordingly, the driver gets a very rough ride.

* * *

WHEN the truck is fully loaded, the deflection of the spring system is greater, its natural frequency is lower, and a larger percentage of the shocks from the road are filtered out.

* * *

Coil Spring Manufacture

I now propose to give you a brief description of the methods employed in the manufacture of coil springs.

* * *

THE coiling of the wire into springs, can be broadly divided into four groups:—

1. **Hand coiled single springs.**
2. **Lathe coiled single springs.**
3. **Semi automatic coiling.**
4. **Automatic coiling.**

* * *

IN the first group, which is usually employed in the manufacture of small quantities of light springs, where quantities are such that it would be uneconomic to use Automatic methods, the wire is fed on to a mandrel of the correct size over a grooved former which controls the pitch of the coils.

* * *

IN the second group, the wire is fed from a swift through rollers on to a mandrel of the correct size. A tripping clutch is mounted to the saddle of the lathe and is operated by a worm and wheel, the worm being mounted on the lead shaft and the worm wheel mounted on a spindle, to which is coupled a spur gear operating in a rack which is mounted on the lathe bed. To this same shaft is fixed the clutch which is operated by a lever. After passing the wire under a catch piece attached to the mandrel, the clutch lever, which is spring loaded, is depressed. The free clutch engages with the fixed clutch which takes up the drive of the worm and wheel. The clutch lever is held in position by a rocker arm carrying a trip mechanism. The worm and wheel are so designed that one revolution of the lead shaft gives a ¼" movement to the saddle. The pitch of the spring is controlled by the gearing on the end train of the head stock. For example, if a ¼" pitch is required, then equal gears are fitted to the head stock and lead shaft. Then, if ½" pitch is required, a gear ratio of two to one is fitted and so on.

* * *

WHEN the correct number of coils and the correct length is obtained, the rocker arm carrying the trip mechanism comes into contact with an adjustable stop mounted on a trip bar which is fixed to the underside of the lathe bed and trips out the clutch operating lever, thus automatically disengaging the clutch and forming one close coil at the end of the spring. The spring is then withdrawn from the mandrel and cut off on a hand press. The saddle carrying the tripping clutch is then wound back to position for the next spring.

* * *

IN the third group, that is, Semi Automatic Coiling, springs are coiled in multiple lengths, thus saving delay in removing springs from the mandrel as is the case with single coiled springs.

(*Please turn to page* 624)

Drawing Copper Wire at Western Electric's Tonawanda Plant

WIRE, whether it be bare, tinned, enameled, or insulated with textiles, paper pulp, or plastics, is one of the most important components of telephone cable, apparatus, and equipment used by the **Bell Telephone Companies** throughout the Nation. When the war ended, the **Western Electric Company,** which is the manufacturing and supply branch of the Bell System, was faced with unprecedented demands for all of its products and to meet these demands it was necessary for the Company to expand its manufacturing facilities. As a part of this expansion, the production of central office cable, magnet wire and other miscellaneous wire products was concentrated in the newly acquired Tonawanda Plant on the outskirts of Buffalo, New York. The appropriate equipment previously used for these products at other Western Electric plants was moved to the new location and very substantial additions of new equipment were provided.

AS the first step in manufacturing its many types and sizes of wire products, the plant has been set up with a wire mill which features all new equipment. This mill (Figure 1) occupies 34,000 square feet of floor space in an open-span area 96 feet between columns and 23 feet from the floor line to the under surface of the six cranes that service the mill. An adjacent area 16 feet wide runs the full length of the mill on two levels. The floor level in this area provides space for inspection, spool repair and storage, and scrap-wire

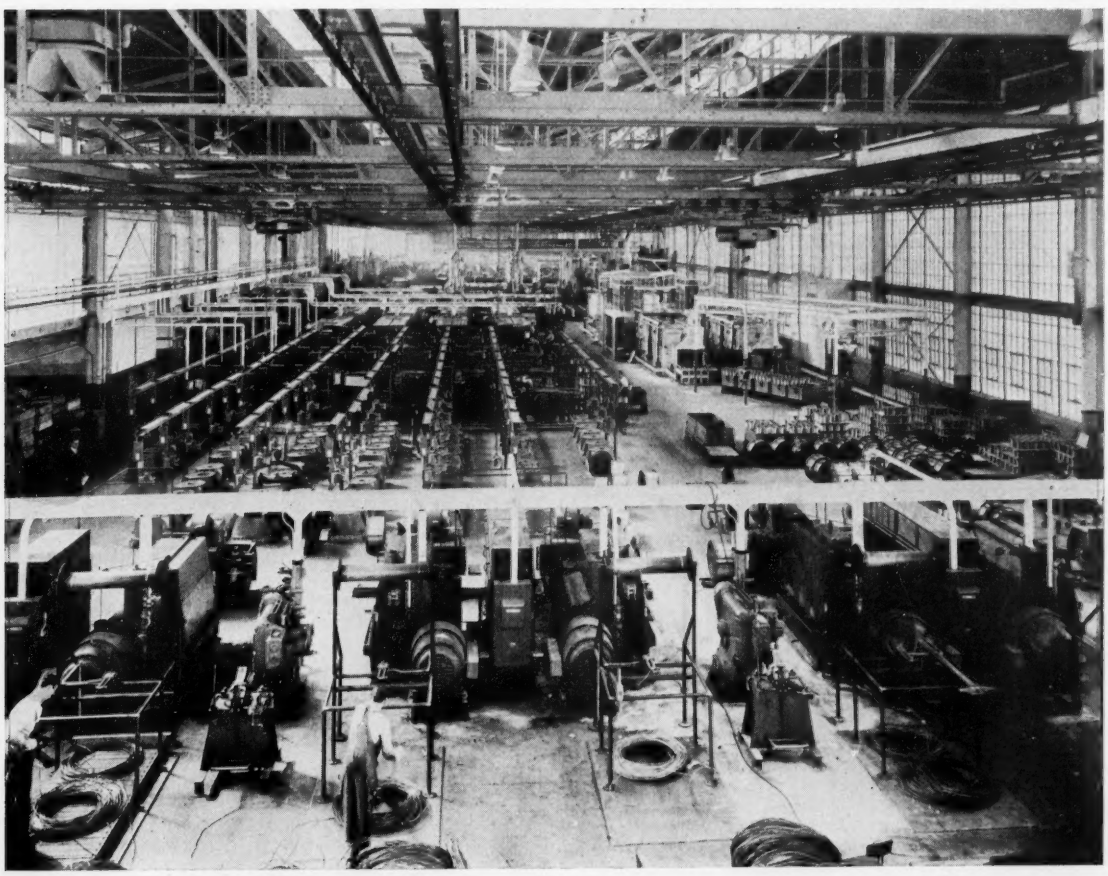

Fig. 1. — Bird's-eye view of wire mill.

packaging. On the mezzanine are locker rooms, shower rooms and the mill offices.

* * *

STARTING with ¼ inch hot rolled copper rod, the wire mill has capacity for drawing approximately 25 million pounds of wire per year. While this would not be a particularly large tonnage for a mill devoted to heavy gauges of wire, it presents a very substantial manufacturing problem to a mill which draws nearly one-fourth of its product into very fine sizes, some finer than a human hair. This is seen in the fact that each year the mill must draw approximately 110 billion feet of wire, enough to circle the globe over 800 times.

* * *

A floor operated crane is used to move the hot rolled rod to the first drawing operation from the adjacent stock pile. Here **Micro-Welders** (Figure 2) are used to join successive coils together to form continuous supplies for six Type D-13 **Syncro** wire drawing machines (Figure 3) from which the wire is taken up at 3,500 feet per minute on spools holding 1,000 pounds.

* * *

Intermediate Wire Drawing

THE 1000 pound spools of 14 gauge supply wire are conveyed by crane to the intermediate wire drawing operation where they are deposited on supply stands which give up the wire over the ends of the spools. There are two stands for each machine, and here again, successive lengths are welded together to form continuous supplies which are conveyed through guides in a series of overhead channels (Figure 4) to the entrance points of the wire drawing units. Advantages thus attained include the elimination of supply spools at each machine position, more consistent welding and an increase in efficiency resulting from a reduction of downtime which would otherwise occur when changing spools.

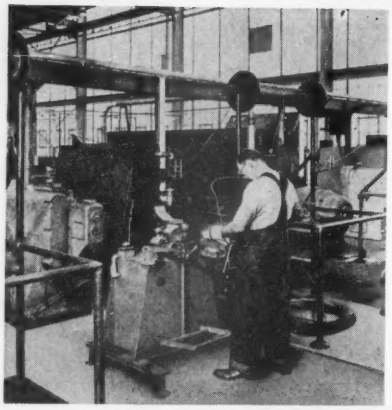

Fig. 2. — Floor-operated crane to move hot rolled rod to first drawing operation. * *

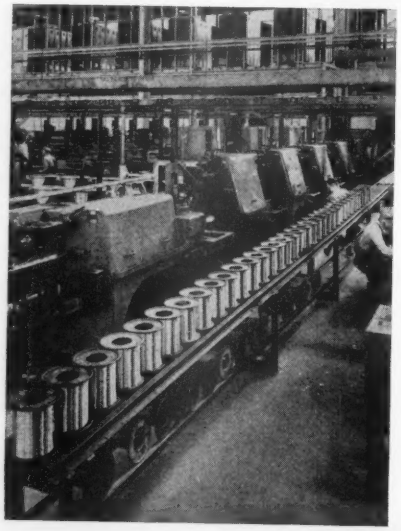

Fig. 5. — Gravity conveyor for handling spools. * * * * *

* * *

OF the 36 intermediate machines, 30 are modified Type B **Syncro** and 6 are Type BB **Syncro** units operating at 3,000 to 4,000 feet per minute. These machines are located back to back in six rows with three operating aisles. Handling is kept at a minimum through the use of a gravity conveyor in each operating aisle (Figure 5). The empty spools roll in channels in the lower section of the conveyor while the full spools are carried away by rollers along the top. The combination of the continuous supply system and the gravity conveyors eliminates the trucking and storing of wire and spools around the machines and makes for exceptionally good housekeeping as well as economy in handling.

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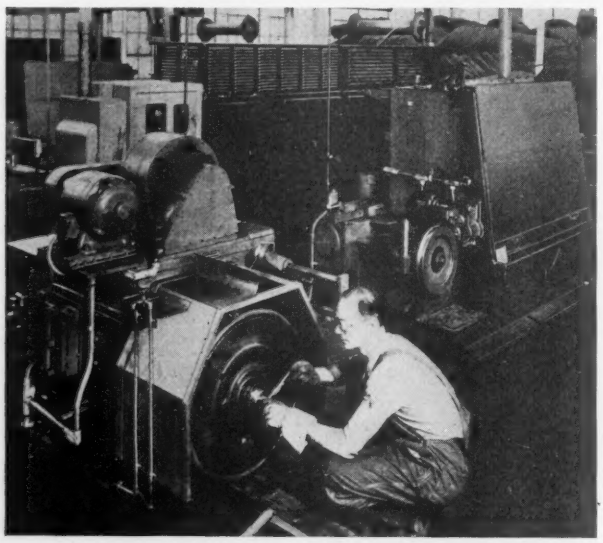

Fig. 3. — Battery of Type D Syncro wire drawing machines. * *

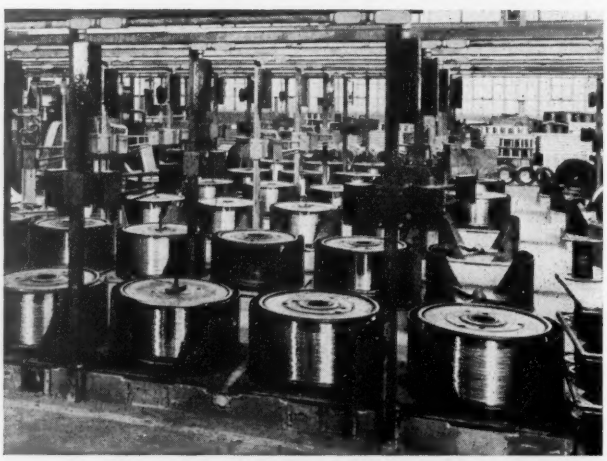

Fig. 4. — Continuous supplies by spools to wire drawing units. * *

Annealing

APPROXIMATELY one-fourth of the output from the intermediate wire drawing machines requires no annealing at any stage of the processing since it is later enameled and the desired properties are attained through such annealing as results during the baking of the enamel. The balance of the wire is loaded on bulkhead-type trays (Figure 6) containing 30 spools each which are pushed intermittently through one or the other of two parallel continuous type bright annealing furnaces (Figure 7).

* * *

BUILT by the **Electric Furnace Company**, these 180 K. W. continuous pusher type electric furnaces incorporate the latest developments in atmosphere and heat control. In addition to the sealing chambers at the two ends, each furnace consists of a multiple zone heating and holding section 20 feet long and a cooling section 50 feet long. The heating is done by resistance grids above and below the hearth and the cooling is by means of water passing through spiral coils extending the full length of the cooling section. A protective atmosphere for keeping the wire bright during the annealing operation is supplied by coke oven gas and air, the mixture being automatically proportioned as it is delivered to the generator where it is burned (Figure 8). The resulting products of combustion are cooled to room temperature, passed through two desulphuring towers, and refrigerated to 40° F. to condense any moisture present before entering the furnace as a slightly reducing atmosphere.

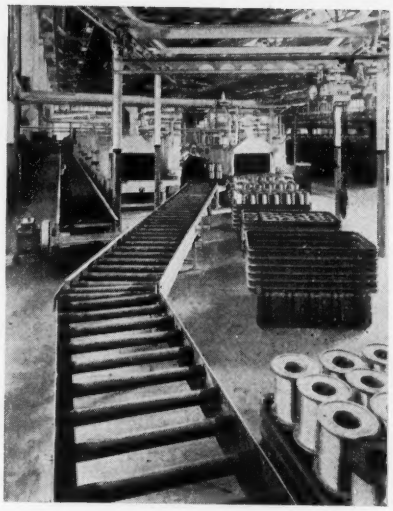

Fig. 7. — Conveyors to continuous type bright annealing furnace. * * * *

* * *

THE controls for this equipment (Figure 9) consist of a **Bailey** continuous recording analyzer which operates a **Selas** proportioning valve to maintain the proper analysis of the protective atmosphere. **Leeds and Northrup** recording controllers are used to regulate the temperature of the heating zones and a **Powers** regulator controls the flow of cooling water.

* * *

AN electric timer controls the hydraulic pusher which intermittently advances the spools of wire through the furnace to emerge approximately 24 hours after they enter. Floor operated cranes are provided at each end for use in loading and unloading the trays. Empty trays from the discharge end of the furnace are returned to the charging end by a motor driven roller conveyor paralleling the full length of the furnace installation. Switches connect this conveyor to the loading positions and either of the two furnaces.

* * *

Fine Wire Drawing

THE 160 fine wire drawing machines, each occupying less than nine square feet of floor space, are arranged back to back in blocks of 16 served by a common distributor. The service connections are of quick acting types so that any machine can be readily removed from the line for maintenance. The units have 4 cone capstans of 4 steps each to provide for a total of 16 reductions. The finished wire is spooled at 3,000 feet per minute,

Fig. 6. — Loading wire for annealing. * * * * *

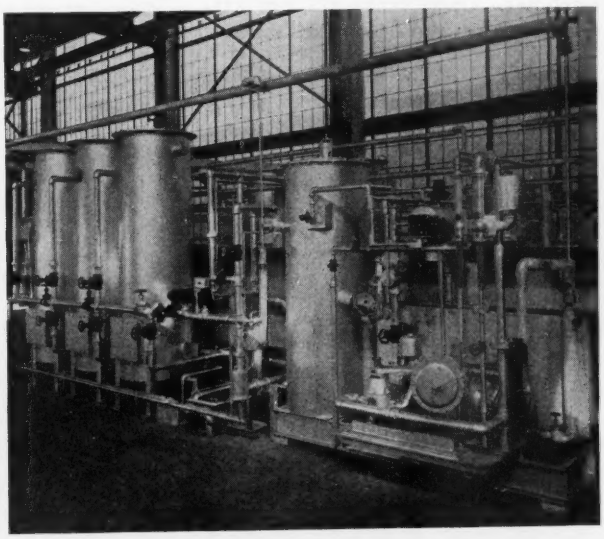

Fig. 8. — Creating a protective atmosphere for the annealing operation.

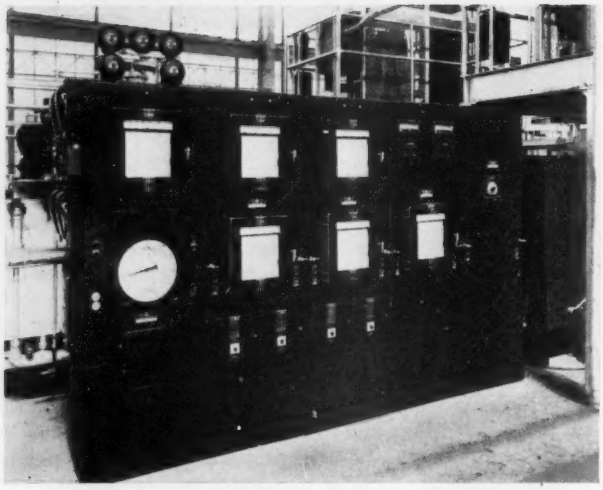

Fig. 9. — Controls for atmospheric equipment. * * * * *

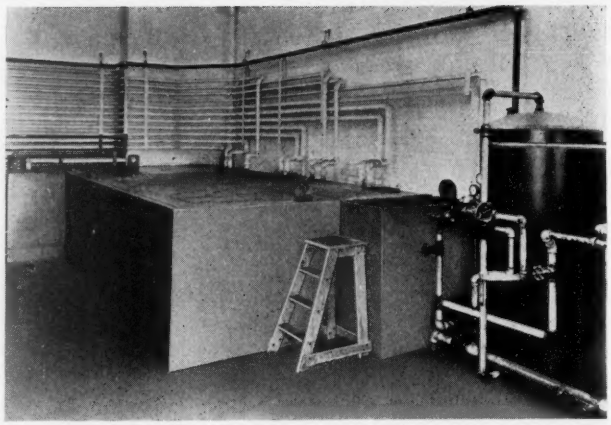

Fig. 10. — 12,000-gallon mixing tanks for wire drawing compounds.

and automatic stops are provided on both the supply and the takeup ends of the machine.

* * *

Wire Drawing Compound

ADJACENT to the mill is a separate room used for the preparation and control of the drawing compounds, a different type of compound being used for each of the three classes of wire drawing machines. The drums of concentrate are heated and dumped into insulated 1,200 gallon mixing tanks (Figure 10) where water is added to give a solution suitable for pumping into the six large service tanks from which the compounds are circulated through the machines. These tanks (Figure 11) are located in the basement and are arranged in pairs so that one can be cleaned while the other remains in service. They are of welded steel construction and are mounted 36 inches above the floor with cleanout doors so that the sludge can be scraped directly into a barrel mounted on a wheeled truck (Figure 12). The barrels of sludge are hoisted through a hatch to the ground level and from there they are trucked to the shipping area to be delivered to a copper refinery for recovery of the copper and fats.

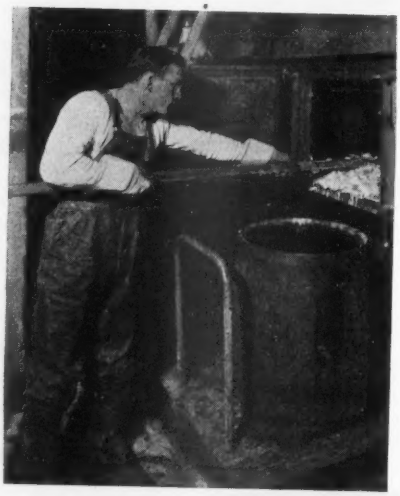

Fig. 12. — Cleaning sludge from service tanks. * * * * *

* * *

FOR control purposes, compound as being supplied to the machines is piped from the pressure pump headers and delivered to three faucets in the testing laboratory. After drawing off a small quantity of compound, true samples are obtained twice daily and these

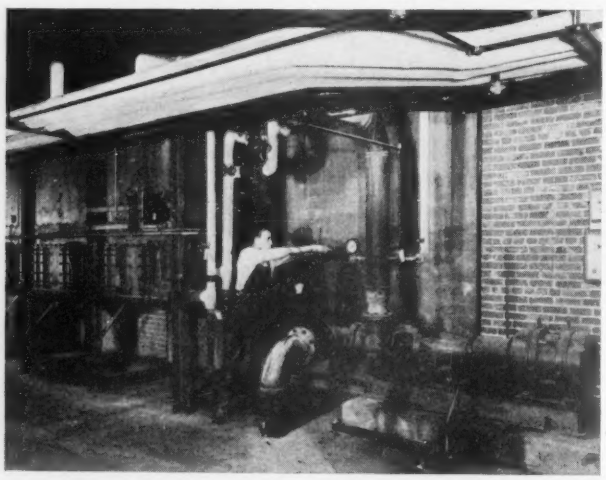

Fig. 11. — Service tanks for wire drawing compounds. * * *

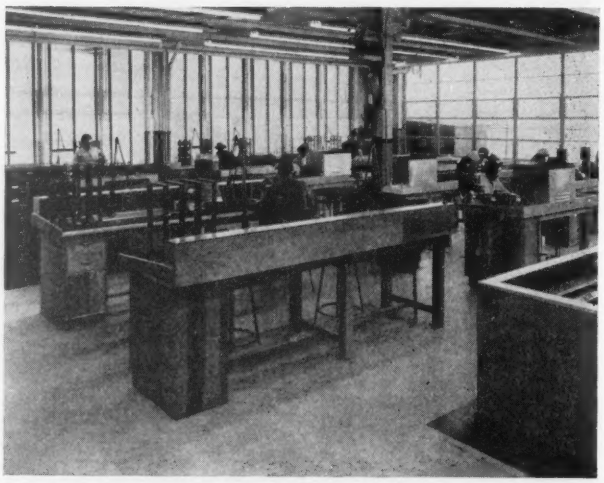

Fig. 13. — The die laboratory. * * * * * *

Fig. 14. — Heavy duty rippers for recutting room dies. * * * *

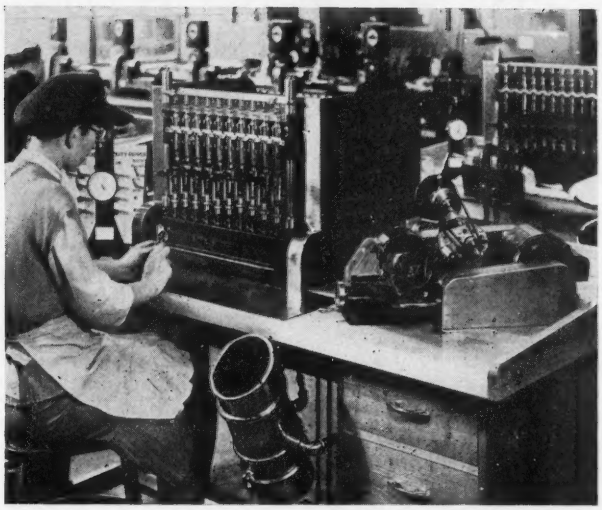

Fig. 15. — 10-spindle drilling machines. * * *

are tested to provide information which permits maintaining optimum conditions of the wire drawing compounds.

* * *

Wire Drawing Die Laboratory

IN planning the Die Laboratory (Figure 13) every effort was made to provide working conditions conducive to extreme care and accuracy of workmanship. Equipment and working areas were arranged in a systematic manner to facilitate the flow of material from cleaning to final inspection.

* * *

WHEN used dies are returned from the mill the first step is to thoroughly clean them in a small vapor degreaser and they are then inspected to determine what attention is required. Worn tungsten carbide dies of No. 12 gauge and larger are routed to the heavy duty rippers (Figure 14) for recutting. These machines, which were designed and built by Western Electric, have centrifugal impellers located at an angle with the base just below the die holding cups. Abrasive solution flowing over the die drops directly on the impeller and is immediately recirculated. The omission of a reservoir eliminates the necessity for a stirring mechanism and permits the use of a minimum amount of abrasive. Worn lapping pins are recut on a precision lathe and the ends are painted with identifying colors for the various die angles.

* * *

ALLOY dies smaller than No. 12 gauge are reworked on 10 spindle drilling machines (Figure 15). A specially developed gauge insures precision in maintaining the proper length and angle of the pressure and land areas (Figure 16). With carefully graded diamond powder, final sizing and polishing is accomplished on single spindle lathes. Each work position for refinishing alloy dies is fitted with an individual cleaning fixture (Figure 17) which uses both water and air under pressure to wash and dry the dies prior to gauging or visual inspection. Large diamond dies are rough cut on 10 spindle machines and all diamond dies are finally polished on 10 and 20 spindle polishing units.

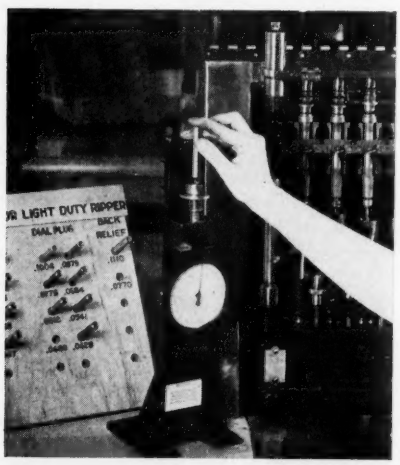

Fig. 16. — Precision gauge for maintaining length and angle of die. * * *

THE volume of work passing through this laboratory is indicated by the fact that the mill uses approximately, new and recut, 50,000 dies per year. The purchases of new dies are much less than this figure since the dies are ordinarily recut several times before being discarded.

* * *

ALTHOUGH the Tonawanda wire drawing mill has been in service for only a relatively short time, it is making a decided contribution to the **Western Electric Company's** efforts to keep pace with the ever increasing demand for facilities to give more and better telephone service.

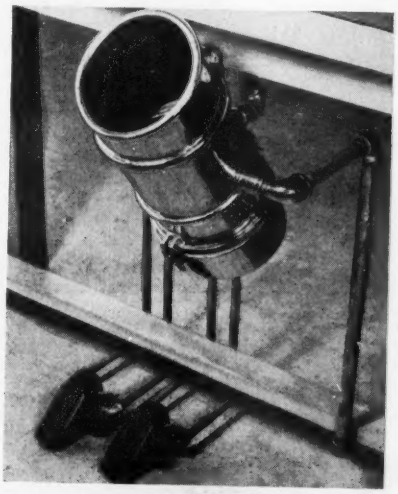

Fig. 17. — Individual cleaning fixture to wash and dry dies prior to usual inspection.

Pacific Coast Regional Meeting of the Wire Association

The Regional Meeting of the Wire Association, held at the Sir Francis Drake Hotel, San Francisco, Calif., June 4th, 1948.

UNDER the able chairmanship of **Earl W. Potter** of the Industrial Wire Cloth Company of San Francisco and Los Angeles, Calif., the annual Pacific Coast Regional Meeting of the Wire Association, held at San Francisco on June 4th, was an unqualified success.

* * *

A group of 85 attended the plant inspection trip through the rod and wire mills of the Columbia Steel Corporation at Pittsburg, Calif. On arrival at the plant, guides were allocated to small groups and complete explanations were given of all operations. An unexpected part of the trip was an opportunity to see the new strip and tinning operations.

* * *

THE group were also guests of the Columbia Steel Corporation at a luncheon in the plant restaurant.

* * *

AFTER returning to the Sir Francis Drake Hotel, the Wire Association gave a "get-together" cocktail party prior to the dinner. A surprise feature was provided by the local committee in the form of a number of door prizes, and much amusement was furnished by Earl Potter who acted as master of ceremonies in their disposal.

* * *

THE door prizes were donated by the following companies:—

PRIZES

Carboloy Company
Electric Clock
Leather Desk Clock—electric
3 Magic Knife Sharpeners

California Spring Co., Los Angeles
Calf-Hide Overnight Bag
Imported Morocco Billfold
Men's Toilet Case

Industrial Wire Products Corporation
Remington "5" Electric Razor
Gold Watch Band

Standard Industrial Compounds Co.
Santa Fe Biltmores
White Horse Scotch

Natural Gas Equipment Co.
White Horse Scotch
Kentucky Tavern Bourbon

K. H. Davis Wire & Cable Corp.
Courteley Set
Bronze Ash Tray

Industrial Compounds Co., Los Angeles (C. R. Mehl)
Scissors Set in Leather Case
Manicure Set in Leather Case

* * *

AT the dinner, which had an attendance of 114, the guest speaker was **Kenneth Smith,** President of the California Redwood Association, who spoke on the topic "Above the Ears of Men". This address will be printed in full in Wire and Wire Products, and the ideas on the American way of life as outlined by Mr. Smith are worthy of full consideration of all who are privileged to read it.

* * *

AFTER the dinner there was a technical meeting, at which the following papers were presented.

1. "The Use of Wire Coating Compounds"
   by Harold L. Trembicki
   Magnus Chemical Co.,
   Garwood, N. J.
2. "Powder Metallurgy"
   by Harry W. Highriter
   Vascoloy-Ramet Corp.,
   Chicago, Ill.

* * *

THE technical session closed with the showing of a sound, color motion picture, "Watts in Glass", provided by the Owens-Corning Fiberglas Company, of Toledo, Ohio.

* * *

THE total attendance was 125, although several of the men who went on the plant inspection trip were unable to remain for the evening session and many attended the meeting who were unable to make the day trip.

A list of the attendance follows:

ARMSTRONG, W. P., Sales Mgr.
Pacific Tube Company
Los Angeles, California

AVERY, OTTO, Wire Mill Foreman
Bethlehem Pacific Coast Steel Co.
South San Francisco, California

BAESSLER, K. H., Supt.
California Wire Cloth Corp.
Oakland, California

BALES, F. H., Ind. Engr.
California Wire Cloth Corp.
Oakland, California

BARBATA, V. A., Sales Repr.
Bethlehem Pacific Coast Steel Co.
South San Francisco, California

BEARD, READE M., Supt. Met. & Insp.
Columbia Steel Company
Pittsburg, California

BELL, R. H., Supt. Bolt & Nut Dept.
Bethlehem Pacific Coast Steel Co.
South San Francisco, California

BEREY, C. W., Supt. Wire Rope Mill
Columbia Steel Company
Pittsburg, California

BISHOP, G. E., Wire & Cable Engr.
General Electric Company
Oakland, California

BLEASH, C. A., Mgr. Industrial Furnace Div.
Natural Gas Equipment, Inc.
San Francisco, California

BOLLIER, J. C., Chief Engr.
Wire Specialties of California
Santa Clara, California

BONDS, E. E., Asst. Supt.
K. H. Davis Wire & Cable Corp.
Los Angeles, California

BROWN, Richard E., Executive Secy.
The Wire Association
Stamford, Conn.

BRUMBAUGH, C. C., Met. Engr.
Bethlehem Pacific Coast Steel Co.
South San Francisco, California

BURNEBY, FRED, Mgr.
Drake Steel Supply Company
Los Angeles, California

CALDWELL, T. E., Asst. Works Met.
Columbia Steel Company
Pittsburg, California

CAREY, G. W., Master Mechanic
California Wire Cloth Corp.
San Francisco, California

CARIDIS, ANDREW A., Engr.
Natural Gas Equipment, Inc.
San Francisco, California

CASAS, C. F., Supt.
K. H. Davis Wire & Cable Corp.
Los Angeles, California

CHRISTIE, C., Prod. Mgr.
K. H. Davis Wire & Cable Corp.
Los Angeles, California

CLARK, C. F., Sales Engr.
Natural Gas Equipment, Inc.
San Francisco, California

CONLAN, J. F., Purch. Agent. Controller
K. H. Davis Wire & Cable Corp.
Los Angeles, California

CORTRIGHT, CHARLES E., Pres.
Cortright Corp.
Glendale, California

DANIELSON, A. H., Met.
Columbia Steel Company
San Francisco, California

DAVIS, K. H., Chairman of Board
K. H. Davis Wire & Cable Corp.
Los Angeles, California

DE POY, J. WILLIAM, Plant Engr.
California Wire Cloth Corp.
Oakland, California

DOBYNE, J. B., Chief Clerk
Republic Steel Corp.
Los Angeles, California

(*Please turn to page* 619)

LABOR RELATIONS

by John B. Stone,
Washington, D. C.

The fifteenth in a series of articles on the subject, with particular reference to problems of the wire and wire products industry. The author is a noted authority on the subject.

MOST signs are pointing toward industrial peace at the price of average wage increases of from six to sixteen cents an hour.

* * *

THIS pattern began to develop as spring turned into summer although the fundamental problems of railroading and coal production were still troubling industry, labor and government. Maritime industrial relations were threatening a breakdown and there were many other sore spots in the national economy.

* * *

BUT developments in the automobile industry where General Motors avoided a strike with its new, modified escalator formula and Chrysler settled a strike with a moderate wage increase, lead labor experts to predict that no nation-wide showdown between labor and industry was on the books.

* * *

IT appeared practically certain that small and medium sized processors in Wire and Wire Products could expect a year of peaceful relations at the expense of such a moderate wage boost.

* * *

THE General Motors peace pact broke what had appeared to be a "united front" of big management against big labor unions. Observers in the national capital were of the opinion that the decision to settle with the union was made in order not to heighten the trend toward scarcity and inflation by causing a general stoppage of production.

* * *

MANY economists here believe that such a general work stoppage could easily unloose the forces of depression. They also recognize that the cost of living has been increasing at a rate which entitles workers to a boost of some 8 cents an hour on that basis alone. They concede that increased wages also may have a noticeable effect on inflation but there was no immediate increase in prices in those cases where wage boosts had been made to avert or end strikes.

* * *

THE idea generally held that most workers were succeeding or had already succeeded in obtaining third round wage increases, however, was deflected by the Department of

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City ..... State .....

Labor. It pointed out that in March only one third of the nearly sixty million workers had been given a third wage increase since the ending of wage controls by the Government.

* * *

MOST spectacular of those who had succeeded of course were the big Auto Workers who conduct negotiations on a nation-wide basis. However Phil Murray's attempt to reopen the steel contract on wages had failed and it appeared that another year would pass before any wage action would be taken in the steel industry generally.

* * *

DEPARTMENT of Labor record books show that many AFL unions conducting negotiations on a small plant basis (with fewer than one hundred workers in each plant) had won wage increases for a third time. These added up in total to several thousand workers.

* * *

COAL and railroad wage increases were still a moot question and the Labor Department figures indicate that the vast majority of unorganized workers, making up more than half of the national labor force, had not been included in the third round.

* * *

THIS means, of course, that if prices continue to rise, a showdown will come in those organized industries which have not granted the third round. Just when and how it will come, to a great extent, depends upon the attitude of management in individual industries and in individual plants.

* * *

HOWEVER, economists here are still predicting something of a recession and some are even declaring that a major depression will strike the country after the November elections.

* * *

THOSE who forsee disaster base their conclusions on the contention that Marshall Plan buying is not great enough to make up for decreased "real wages" of American workers. They insist also that the tremendous Government expenditures on defense preparations will

not come fast enough to prevent an industrial slowdown.

* * *

OF course if the predictions of these economists come true, the slowdown between labor and management when it comes, will not be over increasing wages, but over maintaining those wage scales already in effect.

* * *

AT any rate from the nation's capital the immediate future of labor relations now appears brighter than it has for several months, even though it is impossible to ignore the "distant rumbles" of possible trouble to come.

* * *

Consumption of Silver Holding At High Level

THE many and varied industrial uses of silver during the past year have been at a level more than three times higher than the average annual consumption during the pre-war decade, according to Silver News Letter, published by the Silver Users Association.

* * *

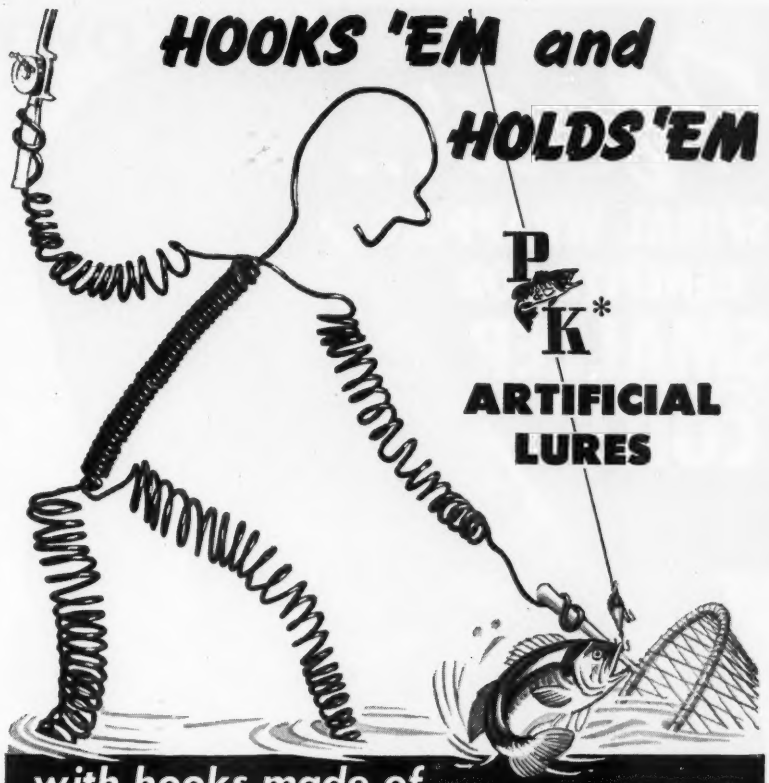
"AMERICAN industries used last year 100,000,000 Troy ounces and it is estimated that consumption will be equally high during 1948," the periodical reports, before the war an annual average of around 30,000,000 ounces went into varied manufacturing processes. As industrial uses here increased, the demand for silver for subsidiary coinage has decreased or ceased in many countries.

* * *

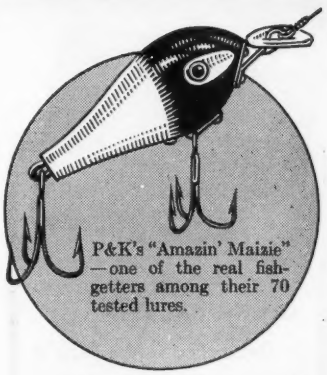
"THE consumption total for 1947 compared with 140,000,000 ounces in 1945 and 120,000,000 ounces in 1944. The drop since has been due chiefly to the virtual disappearance of two items: the silver cladding of main bearings on powerful warplane engines and the manufacture of military insignia, which was six to ten million ounces annually.

* * *

"ONE of the most important expanding uses of silver currently is in the brazing alloys, of which there was a consumption increase of about 25% annually



with hooks made of
KEYSTONE WIRE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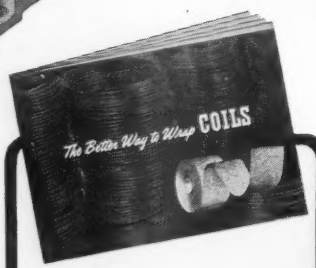

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during the war years. Shortage of tin during the war was a factor in extending the use of the 'hard solder.' Initial material cost was higher, but silver alloys could be applied quickly; they made the strongest brazed joints fitted readily into mass production methods and reduced final costs.

* * *

"THE 'most industry-wide and nation-wide' use of silver is in the electrical industry; chiefly in the silver tips of 'contact points' — unseen, and generally unknown, little gadgets which make-and-break electrical circuits. Though these bits of silver inlay may weigh only a few grains each, the total use of silver in the electrical industry adds up to more than ten million ounces a year.

* * *

"SUCH contact points vary the heat of an electric iron, control oil burners and many kinds of household appliances. They are vital to the operation of automobiles, trucks, farm equipment, streamliners, airplanes. They give the orders to automatic machines of many kinds and do their work with precision and certainty along all the assembly lines of the country."

Large Amounts Of Steel Destined For Export Said To Find Their Way Into The Gray Market

THE steel industry has been told that it should show more responsibility in checking where steel sold for export really goes, because of evidence that considerable amounts of such steel return to this country and go into the gray market.

* * *

THIS was one of several suggestions discussed at a recent meeting of the Senate Small Business Committee, meeting on "the oil and steel supply and distribution" problem with a dozen members of the Steel Products and Steel Producers Industry Advisory Committee.

* * *

THE session was billed as a hearing, but developed into an informal round-table discussion between Senator Wherry and his committee members, and the steel and warehouse interests.

* * *

THE upshot of the discussion was that the advisory committee members were to "sit down" with Commerce Department representatives and "try to work out" some plan whereby small business users of steel would "get a better break".

* * *

THE discussion over exports came when Senator Wherry left the room and placed George Meredith, executive secretary of the committee, temporarily in the chair. Among various things, Mr. Meredith said that the committee is discovering that "a lot of steel is coming from would-be exporters."

* * *

HE asked what was being done by steel companies to make sure that steel they sell to exporters actually is exported. He wanted some check-up made on export licenses, etc., although he did not hold the steel firms responsible for the situation.

Forged Licenses

MR. Meredith also declared that "tremendous quantities" of steel were "being exported on forged export licenses." Some of this, a committee member charged, is returning to the United States and entering the gray market.

* * *

"THAT gray market is not a myth," said Mr. Meredith, and there have been a "tremendous number of complaints," to his committee. He also suggested that small businessmen ease up on making complaints to the FBI about this situation, that a lot of the gray market transactions violate no Federal law. He feels that some other approach should be made.

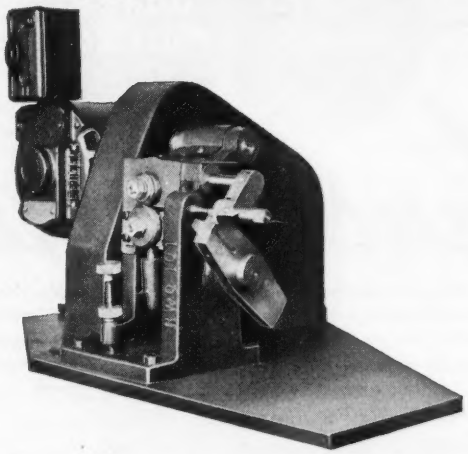
* * *

HE declared that steel companies need to make a more thorough check-up of their system of selling steel. He said some racketeers on the outside, aware of the big profits possible, are not hesitating to attempt to bribe shipping clerks and other trusted employees.

* * *

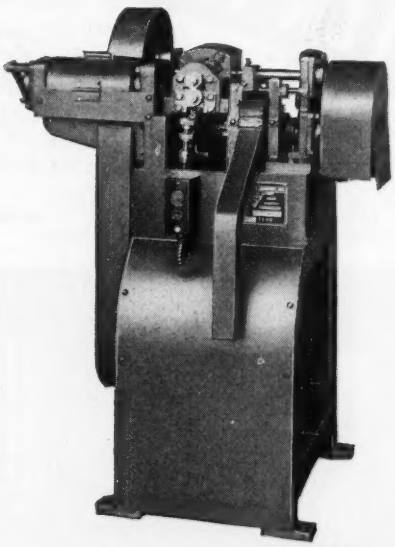
THE committee's aim was said to be to uncover possible patterns being followed, and make them public so that steel producers could become alert and halt such patterns.

TWO NEW MACHINES FOR ULTRA SHORT LENGTHS



The pin cut-off machine above can be set for lengths as short as .050" — in wire sizes down to .006" diameter. This equipment and that shown below meet the increasing demand for machinery to straighten and cut short lengths of wire from a coil.

Glad to quote you on your requirements. When writing, please give maximum and minimum diameter wire and length of cut you intend to make.



This machine cuts heavier wire into short lengths. Other straightening and cutting machines are also available.

THE F. B. SHUSTER MFG. CO., INC., NEW HAVEN, CONN.
3102 MILL RIVER STREET

SHUSTER SINCE 1866

Automatic WIRE STRAIGHTENING AND CUTTING MACHINES

COMBINED "KNOW-HOW"

Carl F. Mayer | John R. Morrison

REPEAT

Announcement!

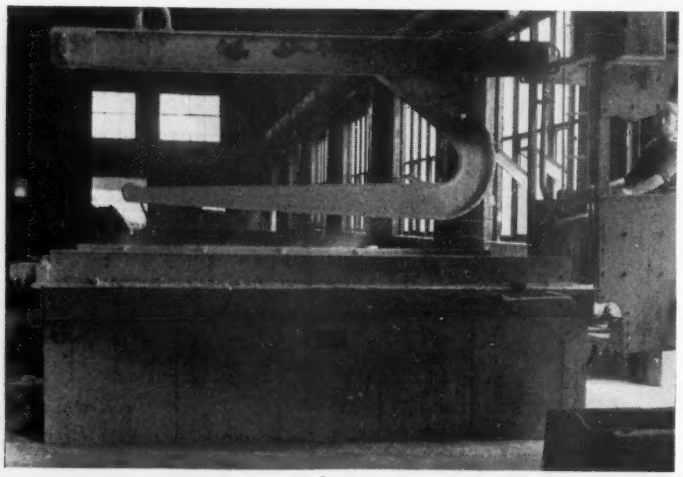
The Carl-Mayer corporation has appointed John R. Morrison (formerly president of Morrison Engineering Corp.) exclusive agent in U.S.A. and Canada, for its complete line of rod and wire bakers. In view of the wealth of experience of Mr. Mayer and Mr. Morrison made available to the wire industry through this exclusive arrangement, we offer to the industry—

MAYER-MORRISON

Hi-Speed Bakers

Covered by one or more of the following patents:

UNITED STATES			CANADA		
2,296,361	•	2,323,828	364,380	•	396,144
2,235,559	•	1,999,513			401,589



THE CARL-MAYER CORPORATION

3030 Euclid Avenue • Cleveland, Ohio

Secretary of Commerce Bestows an A.T.A.E. Award on Industrial Diamond Ass'n of America

PUBLIC attention again has been drawn to the industrial diamond. This time, it is for the service of its trade association to industry and government in Peace, without regard to the diamond's Wartime prestige, when this modern tool worked miracles in precision war production and also in the exploration for scarce minerals and metals.

* * *

THE Industrial Diamond Association of America, Inc., is composed of importers of diamonds and manufacturers of diamond tools. The entry in the contest for the much prized awards of the American Trade Association Executives for Distinguished Service was prepared by the diamond group's Executive Manager, Athos D. Leveridge, to whom Secretary Harriman presented a certificate at the A.T.A.E.'s Spring Meeting's luncheon in the Hotel Statler, Washington. The entry consisted of a brochure entitled "Our Association and its service to its Members, to industry and Government." The problems confronting the industry, the need for organizing the difficulties in the way and how they were solved, were set forth. The association's activities in Membership Cooperation, Trade Fellowship, Cooperation with Government, Research, Public Relations, Good Trade Practices and its international aspects were reviewed and the brochure was illustrated with photostats of substantiating letters, and news clippings, and supplemented with copies of Technical publications sponsored by I.D.A. and of its periodical Member Letter.

* * *

THE President of the Industrial Diamond Association is **Stephen W. Hofman,** Vice Pres. of Diamond Distributor Sales Co., New York; Vice Presidents, **Charles J. Koebel** of Detroit, **Walter J. Meinhardt** of Chicago. Directors are: **I. R. Berk,** Chicago; **O. Ferrier,** Ft. Wayne; **F. E. Koebel,** New York; **I. J. Meade,** New York; **J. A. Ross,** Scranton; **L. Small,** Ferndale; **D. Van Itallie,** New York; and **H. B. Wallace, Detroit.**

* * *

Outstanding Personalities of the Wire Industry

James W. Lafferty Appointment

THE Ira G. Perin Co., San Francisco, material-handling equipment distributor, announces appointment of James W. Lafferty as technical sales engineer. A graduate of the University of Southern California, majoring in electrical engineering, he is 26 years of age. During the war he served with the navy in the South Pacific as a radar specialist.

* * *

MR. Lafferty has been assigned to the Los Angeles office to service the firm's accounts in southern California. Ira G. Perin Co. is California distributor for Elwell-Parker power industrial trucks, Electric Wheel trailers, Powell Pressed Steel containers and platforms, and Hillwood Helyx drive screws.

Frank E. Golliher Named Production Supervisor

APPOINTMENT of **Frank E. Golliher** as production supervisor of the **General Electric Company's Plastics Division** was announced today by Louis S. Gleason, division manufacturing manager.

* * *

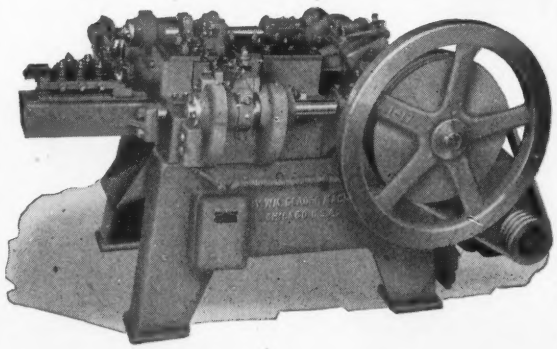
MR. Golliher has been an employee of the General Electric Company for 17 years and came to the Company in 1931 as a member of the business training course. In 1934 he was assigned to the traveling auditor's staff, and in 1937 he came to the Plastics Division as assistant auditor. In 1942 Mr. Golliher transferred to G.E.'s Meriden, Conn. Works as supervisor of the fabricating department, and in 1945 he was appointed to the staff of the manufacturing manager of the Plastics Division. A native of Losantville, Ind., he graduated from Indiana University in 1931.

* * *

W. S. Kisco Forms His Own Company

W. S. Kisco has formed the **• Hedalloy Die Corporation,** Cleveland, Ohio, to manufacture tungsten carbide tools and dies for the bolt and nut industry. He was formerly associated with the Firth-Sterling Steel and Carbide Corporation, for the past few years as sales and service engineer in the Cleveland area, and previously as a service engineer covering the United States and Canada from the main plant in McKeesport, Pa. He had previously been with John A. Roebling Sons Company, Trenton, N. J., for about ten years in various capacities, principally concerned in the maintenance and repair of tungsten carbide dies.

GLADER HIGH SPEED WIRE NAIL MACHINE



MACHINE ARRANGED FOR INDIVIDUAL MOTOR DRIVE

High tonnage output, and low maintenance costs, have resulted in Glader Machines being accepted as standard equipment in every large nail mill built in the United States in the past twenty years.

Glader Machines are operating in most of the wire producing mills throughout the world.

These machines are made in eleven different types and sizes. This enables us to cover the range of sizes of nails produced with the greatest efficiency.

For further information please address,

WM. GLADER MACHINE WORKS

210 No. Racine Ave.
Chicago 7, Illinois

Export Dept.: 122 E. 42nd Street, New York 17, N. Y.

S. S. Gill

THE industry will be interested to note that **S. S. Gill** of the **Indian Steel and Wire Products,** Tatanagar, India, will be leaving in June to return to his own country after more than two years as a student and a worker in the universities and mills of this country.

* * *

HE graduated from Punjab University with honors, a B.Sc., and from the University of Pittsburgh in 1948 with an M.S. Met. Eng. degree.

* * *

HE will return via continental Europe and will visit some mills in England and on the Continent en route.

* * *

MR. Gill has many friends and acquaintances in the industry and wishes to express his appreciation of the assistance and time that was spent on helping him gain a knowledge of wire forming and drawing in the various mills, and its application to his country's manufacturing problem, for his own use.

S. S. Gill, of Indian Steel and Wire Products, Tatanagar, India. * * *

* * *

MR. Gill regrets the termination of his stay in this country but we will hear from him in the things he is going to do upon his return.

* * *

National Electric Products Corp. Elects

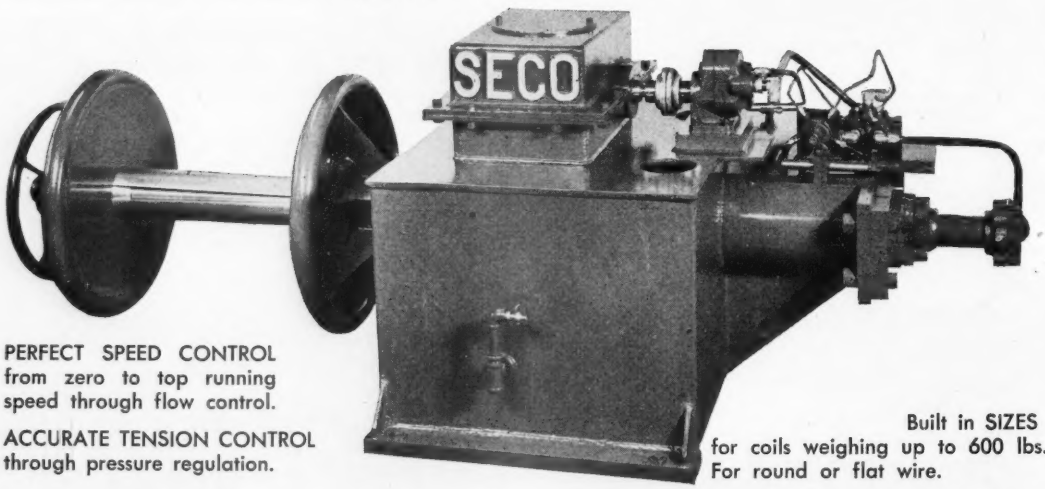
HAROLD J. Newton, sales manager of **National Electric Products Corp.,** Pittsburgh, has been elected by the board of directors to be a vice president of the corporation. This announcement was made by W. C. Robinson, president.

* * *

THE new vice president and general sales manager has devoted his entire business career to the marketing of the company's electrical wire, cable, conduit and raceways. His first position was in 1912 when he became a salesman for I. A. Bennett & Co., Chicago, exclusive sales agents for National

TRAVERSE REELS *Hydraulically* OPERATED

WIRE SPOOLERS, Single & Multiple Type



PERFECT SPEED CONTROL from zero to top running speed through flow control.

ACCURATE TENSION CONTROL through pressure regulation.

Built in SIZES for coils weighing up to 600 lbs. For round or flat wire.

STEEL EQUIPMENT COMPANY

2890 East 83rd Street — F. JULES KELLER, *President* — Cleveland 4, Ohio

Electric. His territory included most of the mid-western states. Mr. Newton came to Pittsburgh in 1929 as eastern district sales manager for National Electric. He was transferred to San Francisco in 1931 and became western sales manager in charge of eleven western states. In 1943, he was appointed sales manager of the corporation and returned to the company's general offices in Pittsburgh.

* * *

NATIONAL Electric Products Corp. has maintained its factory in Ambridge, Pa. for more than 40 years, and recently announced the purchase of a branch manufacturing facility in Torrance, California.

* * *

American Steel & Wire Appointments

RUSSELL M. Braund has been appointed comptroller of **American Steel & Wire Co.**, United States Steel subsidiary, succeeding M. W. Field, deceased. **John W. Jordan** has been named assistant comptroller with added responsibilities.

* * *

BORN in DuBois, Pa., on October 7, 1908, Mr. Braund was educated in the public schools of that community before entering the University of Pittsburgh where he majored in accounting and statistics before being graduated with a B. S. degree. He worked for the Jones & Laughlin Steel Corp. from 1927 to 1930 before joining the United States Steel Corp. in 1931 as a field auditor with the Oil Well Supply Co. He held a number of positions with that organization, and was comptroller at the time of his appointment as assistant comptroller of American Steel & Wire Co. in October, 1944.

* * *

MR. Jordan is a native of Howard, Ohio, having been born there June 22, 1909. He is a graduate of Ohio State University, having earned his B. M. E. degree at that institution. He worked for Bailey Meter Co. in Cleveland and Pittsburgh before joining the Carnegie Steel Co., a U. S. Steel subsidiary, as a fuel-power engineer at its Clairton, Pa., Works in 1933. He joined American Steel & Wire Co. in April, 1943, as supervisor of the cost planning division. Since September, 1944, he has been assistant comptroller in charge of the cost planning and statistical division.

* * *

H. Arthur Howe Named Manufacturing Manager G-E Compound Division

APPOINTMENT of **H. Arthur Howe** as manufacturing manager of the **General Electric Company's Compound Division** was announced today by John L. McMurphy, division manager.

* * *

MR. Howe, a native of Wilmington, Vt., has been superintendent of the Compound Division since February 1947. He has been with the General Electric Company

ADVANTAGES WORTH CONSIDERING

When in the market for cable lacquers, insulating finishes, or impregnating compounds, consult us and have at your command:

1. SPECIALIZED RESEARCH EXPERIENCE
2. RECOGNIZED AND WELL EQUIPPED LABORATORIES
3. SUCCESSFUL PERFORMANCE RECORDS
4. CONFIDENTIAL TEAMWORK

and

5. 77 YEARS OF KNOWING HOW

Our Hot Melt, *Flame Resistant, Non-Toxic* Compounds are most widely used for AF and CF wires.
Your inquiry is invited.

STANDARD VARNISH WORKS

Engineers of Product Finishes

NEW YORK — LINDEN, N. J. — CHICAGO

Serving Industry For 77 Years

since 1933 when he started as a compound test man. Five years later he was named in charge of the compound plant, continuing to hold this responsibility until the end of 1945 when he became operating engineer for the resin and varnish plant.

* * *

Bentley Appointed Assistant to Decatur Manager

THE appointment of **Charles W. Bentley** as assistant to the manager of the General Electric Company's new Decatur, Ill. plastics molding plant has been announced by Charles H. Harris, plant manager.

* * *

A native of Indianapolis, Mr. Bentley attended Indiana University and in 1936 joined the engineering department of the P. R. Mallory Company at Indianapolis. In 1937 he transferred to the Aerovox Company of New Bedford, Mass. where he became production foreman, and in 1940 he joined the Firestone Rubber and Latex Products of Fall River, Mass. where he was manager of that company's plastics division. Before coming to the General Electric Company Mr. Bentley was employed as manager of the compression molding plant of the Pro-Phy-Lac-Tic Brush Company of Florence, Mass.

* * *

W. F. Sewert, Manager of Hardware Products Department The Colorado Fuel and Iron Corporation Wickwire Spencer Steel Division

THE appointment of **W. F. Sewert** as Manager of Hardware Products for the **Wickwire Spencer Steel Division, The Colorado Fuel and Iron Corporation** effective April 26 was announced by Mr. H. C. Allington, General Manager of Sales. Mr. Sewert has been with the Company since 1923. He will continue to operate from the New York office at 500 Fifth Avenue, New York 18, New York.

322 Employees on SKF 20-Year Roll

SKF Industries, Inc., now has 322 persons on its honor roll of employees who have been associated with the ball and roller bearing firm 20 years or more. This represents more than eight per cent of the total employment in plants in Philadelphia and Shippensburg, Pa., and Hornell, N. Y.

* * *

OF this number, 242 are still in active service, including **William L. Batt**, president, one of three employees with a record of 40 or more years of continuous service. The company awards gold watches to new 20-year employees and silver platters to those reaching the 40-year mark.

* * *

Die Company Organized to Serve Midwestern Wire Mills

A new company, **Bronson & Bratton, Inc.**, with offices at 4117 South Western Blvd., Chicago, has been organized to operate as a manufacturers' representative in the

Hi-Efficiency

HMT
ESTABLISHED HUGHESVILLE MACHINE & TOOL COMPANY 1846
WIRE & PROCESS MACHINERY

Standard and Special Equipment for the Wire Industry

STRANDERS • SCRAP BALERS • STRAIGHTENERS
WINDERS • CHEMICAL MIXERS • GRINDERS • COILERS
PROCESSING EQUIPMENT • SPECIAL PURPOSE MACHINERY • PATTERN & TOOL MAKERS

HUGHESVILLE MACHINE & TOOL COMPANY

Hughesville Machine & Tool Co.
54 Academy Street
Hughesville, Pa.
Phone 129A

Thomas S. Hughes
35 Admiral Road
Toronto 5, Ontario, Canada
Phone—Kingsdale 3356

cold drawing and cold heading industries of the midwest.

* * *

EFFECTIVE April 1, 1948, this company was appointed by Carboloy Company, Inc., as it's die sales agent for the Midwestern District, and in this capacity **Bronson & Bratton, Inc.** will handle the sales and service of Carboloy dies in that area. Local stocks will be increased and service shop facilities expanded. In the near future this firm will round out its line of products through similar arrangements on diamond dies, drawing compounds, and machinery.

W. D. Bronson, President, Bronson & Bratton, Inc., Chicago, Illinois. * *

* * *

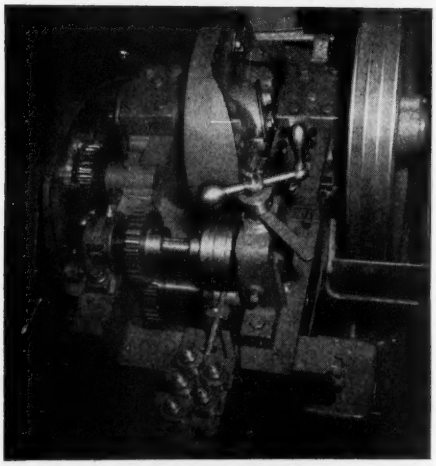
AS the name indicates, this new firm is headed by **W. D. Bronson** and **W. J. Bratton**, both members of the Wire Association, and both well known in wire mill circles. **Mr. Bronson** entered this field in 1930, shortly after his graduation from Carnegie Institute of Technology, as a Sales Engineer for Union Wire Die Corporation. He joined Carboloy Company in 1937 at the time Carboloy purchased Union's carbide die business. In 1942 he was appointed District Manager in charge of Carboloy's Midwestern District, a position he held at the time of his resignation to form his own company.

* * *

MR. Bratton began his business career with General Electric Company, following his graduation from Washington State College, in 1936. He joined the Carboloy Company in 1937, and spent five years in the company's General Offices in Detroit under J. R. Longwell and K. R. Beardslee. In 1942 he was assigned to field work in the Chicago area, specializing in drawing die applications.

W. J. Bratton, Bronson & Bratton, Inc., Chicago, Illinois. * * * * *

1000 STAPLES PER MINUTE!!!



Top View, showing Fly Wheel and Gears

FENCE STAPLES — POULTRY NETTING STAPLES — DOUBLE POINTED TACKS (WIRE CLOTH TACKS)

Fastest Staple Cutter Ever Made — Makes Two Complete Staples at each revolution — Compact, Easily Adjustable, Efficient.

48 Different Leg Lengths, Gauges 9 through 18

Can Be Made With

HUMPHREY RAPID STAPLE CUTTER

Early Deliveries of Belt or Motor Drive Machines Now Possible. Send for complete details and prices.

Manufactured Exclusively For

REED and RICHARDS TRANSATLANTIC, INC.

CHANIN BLDG., 122 EAST 42nd ST., NEW YORK 17, N. Y., U.S.A.

REG. CABLE ADD.. "LOUREED, NEW YORK".

Also Bale Tie Machines, producing single loop, round or oval ties, 2000 per hour; 3 to 16 ft.

AMERICAN IRON AND STEEL INSTITUTE
SHIPMENTS OF STEEL PRODUCTS
ALL GRADES INCLUDING ALLOY AND STAINLESS
(Net Tons)

AIS 10

APRIL - 1948
Month

Steel Products	Number of companies	Items	Current Month: Net Shipments (Excluding Shipments to Members of the Industry for Conversion into Further Finished Products or For Resale) (Net Tons)	Current Month: Per cent of Total Shipments	Current Month: Shipments to Members of the Industry for Conversion into Further Finished Products or For Resale (Net Tons)	To Date This Year: Net Shipments (Excluding Shipments to Members of the Industry for Conversion into Further Finished Products or For Resale) (Net Tons)	To Date This Year: Per cent of Total Shipments	To Date This Year: Shipments to Members of the Industry for Conversion into Further Finished Products or For Resale (Net Tons)	Whole Year 1947: Net Shipments (Excluding Shipments to Members of the Industry for Conversion into Further Finished Products or For Resale) (Net Tons)	Whole Year 1947: Per cent of Total Shipments	Whole Year 1947: Shipments to Members of the Industry for Conversion into Further Finished Products or For Resale (Net Tons)
Ingots, blooms, billets, tube rounds, sheet and tin bars, etc.	43	1	210,859	4.1	250,173	* 1,021,790	4.8	* 1,066,091	2,966,748	4.7	2,396,343
Structural shapes (heavy)	12	2	302,244	5.9	2,882	1,342,878	6.3	11,095	4,436,129	7.0	2,640
Steel piling	4	3	21,083	0.4	-	99,356	0.5	8	324,224	0.5	23
Plates (sheared and universal)	29	4	528,040	10.4	23,648	* 2,226,603	10.4	127,819	6,345,216	10.1	219,227
Skelp	6	5	11,526	0.2	19,280	52,405	0.2	139,167	160,989	0.3	384,004
Rails—Standard (over 60 lbs.)	4	6	126,030	2.5	265	636,745	3.0	3,518	2,207,146	3.5	991
—All other	5	7	18,996	0.4	191	87,149	0.4	595	211,900	0.3	329
Joint bars	7	8	13,065	0.3	3,275	49,636	0.2	12,504	173,923	0.3	15,198
Tie plates	7	9	39,699	0.8	32	165,730	0.8	211	504,779	0.8	4,437
Track spikes	8	10	9,322	0.2	-	44,994	0.2	90	163,746	0.3	146
Hot Rolled Bars—Carbon	34	11	481,406	9.4	42,898	* 2,081,139	9.7	* 215,808	6,242,416	9.9	745,770
—Reinforcing—New billet	16	12	102,888	2.0	449	438,585	2.0	2,363	1,277,075	2.0	9,775
—Rerolled	13	13	19,850	0.4	-	60,490	0.3	-	175,833	0.3	-
—Alloy	27	14	152,515	3.0	20,542	* 629,398	2.9	77,185	1,741,432	2.8	212,382
—TOTAL	44	15	756,659	14.8	63,889	* 3,209,612	14.9	* 295,356	9,436,756	15.0	967,927
Cold Finished Bars—Carbon	27	16	107,668	2.1	543	459,231	2.1	1,516	1,426,701	2.3	9,249
—Alloy	26	17	20,537	0.4	311	* 71,382	0.3	1,564	218,802	0.3	2,601
—TOTAL	35	18	128,205	2.5	854	* 530,613	2.4	3,080	1,645,503	2.6	11,850
Tool steel bars	19	19	7,461	0.1	139	* 27,664	0.1	445	87,279	0.1	1,670
Pipe & Tubes—Butt weld	15	20	151,040	3.0	2,227	* 643,120	3.0	9,336	1,892,691	3.0	78,080
—Lap weld	8	21	24,449	0.5	3	118,201	0.5	3	389,762	0.6	875
—Electric weld	13	22	101,312	2.0	439	483,319	2.3	1,673	1,254,325	2.0	4,274
—Seamless	17	23	241,511	4.7	13,753	* 945,289	4.4	58,602	2,581,106	4.1	157,208
Wire rods	19	24	45,957	0.9	25,099	217,453	1.0	103,524	667,282	1.1	331,192
Wire—Drawn	39	25	212,793	4.2	13,730	897,553	4.2	59,873	2,590,963	4.1	181,783
—Nails and staples	17	26	73,733	1.4	1,366	290,320	1.4	5,065	799,436	1.3	8,481
—Barbed and twisted	15	27	20,454	0.4	20	88,705	0.4	48	256,991	0.4	128
—Woven wire fence	13	28	33,047	0.7	391	133,703	0.6	1,143	407,295	0.6	3,616
—Bale ties	11	29	9,441	0.2	-	39,938	0.2	-	119,917	0.2	-
Black Plate—Ordinary	9	30	63,876	1.3	-	260,087	1.2	562	801,745	1.3	2,033
—Chemically treated	2	31	2,135	-	-	4,447	-	-	19,252	-	-
Tin and Terne Plate—Hot dipped	8	32	168,627	3.3	27	656,179	3.1	99	2,093,149	3.3	228
—Electrolytic	9	33	141,060	2.8	-	560,969	2.6	215	1,617,659	2.6	529
Sheets—Hot rolled	32	34	606,156	11.9	50,294	*2,563,720	12.0	220,160	7,891,798	12.5	578,426
—Cold rolled	16	35	567,756	11.1	1,823	2,202,899	10.3	6,981	5,504,578	8.7	28,498
—Galvanized	16	36	136,393	2.7	288	536,975	2.5	1,015	1,609,881	2.5	889
Strip—Hot rolled	23	37	131,618	2.6	34,805	554,851	2.6	121,492	1,740,085	2.7	308,655
—Cold rolled	33	38	148,286	2.9	1,983	580,016	2.7	7,977	1,613,005	2.6	28,030
Wheels (car, rolled steel)	5	39	25,743	0.5	31	105,418	0.5	355	356,873	0.6	2
Axles	5	40	17,585	0.3	1	65,256	0.3	75	185,019	0.3	53
All other	-	41	-	-	-	-	-	-	-	-	-
TOTAL STEEL PRODUCTS	140	42	5,096,161	100.0	510,908	*21,443,573	100.0	*2,258,177	63,057,150	100.0	5,717,765

During 1947 the companies included above represented 99.5 % of the total output of finished rolled steel products as reported to the American Iron and Steel Institute.

* Adjusted.

NOTICE TO SUBSCRIBERS

The 1948 WIRE & WIRE PRODUCTS BUYERS GUIDE and Year-Book of the Wire Association

is now ready

The 1948 Edition of this useful directory may be obtained by subscribers at 40% discount from the list price of $5.00 per copy. So when ordering your subscription to WIRE AND WIRE PRODUCTS, if you want a copy of the BUYERS GUIDE, please enclose $3.00, or send the order and ask us to bill you.

Members of the WIRE ASSOCIATION will continue to receive a copy of the BUYERS GUIDE as part of the service extended to them, and the cost is included in the dues.

To all others the price remains as heretofore $5.00 per copy.

THE BUYERS GUIDE is a complete directory of all kinds of wire and wire products manufactured in the country, together with listings of all machinery, equipment, supplies and services used by the Wire Industry.

It is an invaluable source of information on everything of interest to wire men. Be sure to order your copy early to be certain of getting one, as the edition is limited. Published in the Spring annually . . . Only $3.00 to subscribers.

WIRE & WIRE PRODUCTS

300 MAIN STREET STAMFORD, CONN.

A Review of Recent Wire Patents

No. 2,440,749. APPARATUS FOR PACKAGING SAFETY PINS, patented May 4, 1948 by George E. Klock, Neenah, Wis., assignor to International Cellucotton Products Company, Chicago, Ill., a corporation of Delaware.

The machine is adapted to feed safety pins in spaced-apart positions between two tape strips and sealing the strips around the pins after they are inserted.

No. 2,440,802, METHOD OF MAKING ELECTRICAL CONDUCTORS, PATENTED May 4, 1948 by Christopher J. Krogel, Cranford, N. J., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

About the wire core is a water emulsion consisting of polyvinyl acetate, polyvinyl alcohol or methyl methacrylate polymer. On the wet coated core is a sheath of insulating pulp fibres.

No. 2,441,003, LAPPING MACHINE FOR WIRE DRAWING DIE COMPACTS, patented May 4, 1948 by Paul Bieberich, Fort Wayne, Ind.

Support for the lapping tools-supporting spindles is provided, arranged so that they are accurately confined in operating positions thruout their various movements.

No. 2.441.004, MACHINE FOR LAPPING WIRE, patented May 4, 1948 by Paul Bieberich, Fort Wayne, Ind.

The purpose of the invention is to dress the wall of the bore of a die compact after it has been pierced preparatory to the lapping operation. A laterally swaying support is provided for the compact that is adjustably movable with respect to the lapping tool without altering the extent of the swaying movement of the support.

Nos. 2,441,166 — 2,441,167. HELICAL SPRING. patented May 11, 1948 by August Raspet, Locust Valley, N. Y.

These patents relate to helical springs manufactured in such a way that their behavior in use can be predicted with mathematical exactness, it is said.

No. 2.441.228. AUTOMATIC GRID WINDING MACHINE patented May 11, 1948 by Gerhard Gunther, Schneider and Frank L. Donohue. Maplewood. N. J., assignors to National Union Radio Corporation, Newark, N. J., a corporation of Delaware.

There are 30 claims. The machine is said to be adapted to wind grids of variable pitch.

No. 2,441,439. METHOD AND MACHINE FOR WINDING COILS. patented May 11, 1948 by Rolland D. Nelson, Hales Corners, Wis., assignor to Line Material Company, South Milwaukee, Wis., a corporation of Delaware.

More specifically the method is for winding a conducting coil on a shell surrounding a magnetic core and comprises the positioning a shell around a part of the core and starting to coil around the shell, supporting the coil at spaced points by revoluble members directly engaging the coil, rotating one of the members to rotate the coil and shell and winding a conducting winding on the shell, and simultaneously and progressively positively moving all of the revoluble members radially outwardly the same amount while the winding builds up radially to thereby hold the shell out of contact with the core.

No. 2,441,541, WIRE CUTTING MACHINE, patented May 11, 1948 by Joseph F. Hidzick, San Francisco, Calif.

Associated with the cutter are means for straightening the wire before advancing to be cut, the feeding device being so arranged that it does not interfere with the cutter upon its return from the cutting operation.

No. 2,441,544, STRIP UNCOILER, patented May 11, 1948 by William F. Longfield, Cleveland, Ohio, assignor to The Cleveland Punch & Shear Works Company, Cleveland, Ohio, a corporation of Ohio.

New coils may be loaded quickly, it is said, as soon as a coil is used up, all without employing a crane.

No. 2,441,639, WIRE PAY-OFF REEL, patented May 18, 1948 by William V. Larner, Parma, Ohio, assignor to The American Steel and Wire Company of New Jersey, a corporation of New Jersey.

Snarls are prevented despite high-speed feeding of the wire. There are 10 claims.

No. 2,441,670, ANTISKID DEVICE FOR VEHICLE TIRES, patented May 18, 1948 by Joseph A. Morrone, Westerly, R. I., assignor to Morrone Manufacturing Co., Westerly, R. I., a corporation of Rhode Island.

The device comprises a metallic resilient bar developed into a looped por-

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tion adapted to be stretched across the tire tread, this looped portion having inclined end portions terminating in inwardly directed toothed ends for biting into the tire on opposite sides of its tread.

No. 2,442,183, MEANS FOR IMPREGNATING ELECTRIC COILS, patented May 25, 1948 by Harry C. Stearns, Glen Ellyn, Ill.

This apparatus includes a tank containing an impregnating varnish, a cross member adapted to support a number of coils, a device to raise and lower the cross member to dip all of the coils in the varnish, means to pass current through the coils to eliminate moisture therefrom, and automatic means to sever the current flow through the coils during a period when they are submerged in the varnish to prevent internal drainage upon their removal from the varnish.

No. 2,442,307, INSULATED ELECTRICAL CONDUCTOR, patented May 25, 1948 by William McMahon, Summit, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York.

A jacket surrounds the wire conductor and is formed of a non-metallic material susceptible to bacterial or fungal attack, which jacket has associated therewith a protective compound which because of its temperature–viscosity relationship must be heated to a temperature of at least 100°C. during its application to the jacket, the protective compound containing a biocidal agent which is compatible with the protective agent, and which does not decompose at temperatures up to 160° C., the biocidal agent being zinc pentachlorophenate.

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* * *

New Wax to Prevent Rust Announced

A water-emulsion wax that is now being successfully used as a rust-inhibiting coating for metals has been developed by **S. C. Johnson & Son, Inc.**, Racine, Wisconsin. It is being marketed as Johnson's Rust-Inhibiting Wax No. 1568.

* * *

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* * *

DESCRIPTIVE literature on this product is now available by writing to the manufacturer.

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1948 WIRE BUYERS GUIDE

Sensitivity of Different Steels to Pickling Brittleness

(*Continued from page* 569)

time depends upon those basic factors discovered in the first portion of the study, now modified by changes in hydrogenizing surface conditions.

* * *

FIRST, note in Figure 4 that the entire collection of 410 and 431 stainless steel, with but a single exeeption, resists acid pickling brittleness completely, so far as this test can detect. This is consistent with the predicted difference between cathodic and acid pickling, for these steels in the hardened condition are both basically susceptible in high degree to pickling brittleness; yet their property of corrosion resistance causes a marked reduction in surface hydrogen concentration during straight acid pickling, as compared, for example, with mild steel.

* * *

ONLY the hardened-and-cold-drawn 431 disclosed embrittlement; and that is especially remarkable because in cathodic pickling the coldworking effected but little increase in the sensitivity of the hardened steel. Perhaps here the answer lies in the greater chemical attack of coldworked metal, which will produce greater severity of hydrogenizing.

* * *

ON the other hand, comparison of the previous Figures 2 and 3 discloses that hardened-and-cold-drawn 410 is more badly embrittled than 431 in similar condition; yet 410 in acid pickling is less susceptible. This is not readily blamed on a difference in metal attack, since 431 is certainly less attacked than 410, though that was not specifically determined here. Perhaps the nickel content of 431 is responsible, since nickel dissolves more hydrogen than does iron.

* * *

AGAIN, we find the SAE 1060 and 1090 steels consistently resistant to embrittlement, just as they were in cathodic pickling — and this in spite of violent metal attack. SAE 1020, however, embrittles badly, as it did in cathodic pickling, and in almost identical relationship to 440-C, also shown in Figure 4. This constitutes another interesting observation, for SAE 1020 and Type 440-C might well be expected to behave quite differently under the two pickling conditions.

* * *

Hydrochloric Acid

7% Solution

TWO concentrations of HC1 were studied because of the commercial significance of each, and because of the interest in comparing HC1 with H_2SO_4.

* * *

IN the dilute solution (see Figure 5), the results are closely analogous with those for dilute H_2SO_4, with two exceptions. First, the susceptibility of the 431 grade has slightly increased, aggravating embrittlement in the hardened and cold-drawn material, which also failed in H_2SO_4, and disclosing in addition a slight susceptibility of the same material before cold-draw-

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ing. Thus, two sets of specimens of 431 now disclose susceptibility, whereas 410 remains resistant. This behavior of 431 continues to be a mystery, for this steel is known to be considerably more resistant to HC1 than is 410.

* * *

SECOND, the mild steel SAE 1020 (black circles) and the stainless steel 440-C (white circles) have **reversed** their relative positions. In H^2SO^4, the stainless steel is less embrittled than the carbon steel; whereas the oposite is true for dilute HC1. In this case an explanation may be available, for the chromium-containing steels are notoriously subject to attack by halide ions, of which C1- is one.

* * *

50% Solution

SINCE a 1:1 mixture of $HC1/H_2O$ is sometimes used as a metal cleaner, particularly for stainless steel, the tests were repeated in a 50% solution.

* * *

IN Figure 6 one sees that all 431 have returned to an indication of nonsusceptibility, along with 410 and the SAE 1060 and 1090. The concentrated acid is therefore less damaging than the dilute.

* * *

ANOTHER change concerns annealed 440-C and SAE 1020, which again reverse positions, returning closely to their respective relationships in 10% sulfuric acid. This might indicate a lesser susceptibility of the stainless steel to the C1- ion when in concentrated solution. It is not clear whether there is any special significance to the extremely low bend values of the cold-drawn 440-C in the 1:1 bath.

* * *

Phosphoric Acid

A 4-normal pickling solution of H_3PO_4, injured 440-C and SAE 1020 much the same as did the other acids. (See Figure 7.) None of the other steels showed susceptibility.

* * *

Acetic Acid

THE effect of 4-normal acetic acid, CH_3COOH, rendered very similar results, except that embrittlement initiate more slowly, and the cold-drawn 440-C was not depressed to such extremely low bend values as in the other acids. (See Figure 8.)

* * *

ON the other hand, it perhaps comes as a surprise to some that these weaker acids, phosphoric and acetic, can actually create embrittlement problems as severe as those from sulfuric and hydrochloric.

* * *

Other Acids

NITRIC (HNO_3), hydrofluoric (HF), and combinations of these two acids were studied, principally because of their usefulness in the stainless steel industry.

* * *

NITRIC acid, under extended test conditions, revealed no embrittling effect upon any of the stainless steels, though some embrittlement seemed to be caused in SAE 1020 under certain conditions having no commercial significance.

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MIXTURES of HNO_3 and HF, throughout their commercially useful range, similarly caused no embrittlement of stainless steel; although HF alone caused severe embrittlement, much like that of the other halide acid, HC1.

* * *

Conclusions

FROM this study the following conclusions can be drawn regarding the susceptibilities of various steels to pickling brittleness:

[A] In cathodic pickling, where surface concentration of the hydrogen can be closely controlled by regulation of current density, factors within the steel are disclosed which affect susceptibility to hydrogen embrittlement:

I. Annealed steel is least susceptible, hardened steel most; and coldwork further increases the susceptibility of either condition such that the conditions can be listed in the following order of increasing susceptibility:

annealed
annealed-cold-drawn
hardened
hardened-cold-drawn

II. Among the stainless steels, the thermally hardenable (martensitic) grades are the most susceptible to hydrogen embrittlement;

III. Increasing carbon content increases the susceptibility of hardened steels, alloyed or unalloyed;

IV. Increasing carbon content also increases the susceptibility of annealed stainless steel; but it decreases the susceptibility of "air-patented" carbon steel;
V. Cold-drawn SAE 1020 embrittles comparably with annealed 440-C stainless steel;

VI. Annealed 410 and 431 stainless steels resist embrittlement even when cold-drawn;

VII. Hardened 410 and 431, even when cold-drawn, will bend 180°; but hydrogenizing conditions rapidly induce embrittlement which becomes as severe as that for hardened 440-C;

[B] In acid pickling, these basic relationships of the steel are modified by the degree of metal attack because it controls the hydrogenizing conditions. As a result:

I. With the exception of 440-C, the stainless steels are less susceptible to embrittlement in acid pickling than they are in cathodic pickling, where the hydrogen supply is not dependent upon chemical attack;

II. Type 410 shows nonsusceptibility in all conditions;

III. Only in the hardened and cold-drawn condition does Type 431 stainless steel show embrittlement, and then only in dilute H_2SO_4 and dilute HC1;

IV. In phosphoric acid and acetic acid both 410 and 431 are resistant;

V. Type 440-C stainless steel and SAE 1020 mild steel retain similar relationships in either acid or cathodic pickling; and SAE 1060 and 1090 remain resistant as before;
VI. Hydrochloric acid in 7% strength is slightly more damaging to 440-C than is 10% H_2SO_4, probably because of the sensitivity of chromium steel to chloride ion attack; but the effect does not appear with 50% HC1;
VII. All of the acids studied except HNO^3 cause similar injury in equal pickling times, particularly as reflected in the bend values for SAE 1020 carbon steel and Type 440-C stainless steel.

* * *

Acknowledgment

ACKNOWLEDGMENT is due the Office of Naval Research, under whose sponsorship an extensive study of gas-metal systems is being conducted; the American Society for Metals, whose publications listed as Refs. 7 and 8. contain much of the described work; and O. G. Specht, Jr., of Grede Foundries, Milwaukee, who conducted some of the experimentation.

* * *

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Trans. Am. Soc. Metals 39, 213-37; disc., 237–40 (1947)

EDITOR'S NOTE

THE following lines were inadvertently omitted by our printer from **Messrs. Zapffe & Haslem's** article "The Relationship Between Coldworking & Hydrogen Embrittlement" published in our previous (June) issue. These lines follow directly at the end of page 478 and before the carry-over on page 527:

that recovery from embrittlement at temperatures too low to effect **recrystallization** leaves the metal in a partly expanded condition after the embrittling portions of the gas have escaped[5]. If the metal is now recharged with hydrogen, much larger quantities are absorbed, in conformity with the concept that the actual void volume within the grain has been increased by the previous action of the gas. Direct experiments with extremely high pressures of molecular H_2 verify this concept, for after stressing steel with pressures in the neighborhood of 100,000 psi of H_2, the steel is rendered readily pervious to the molecular gas, and even to some liquids, until recrystallization at elevated temperatures repairs the texture[6, 7].

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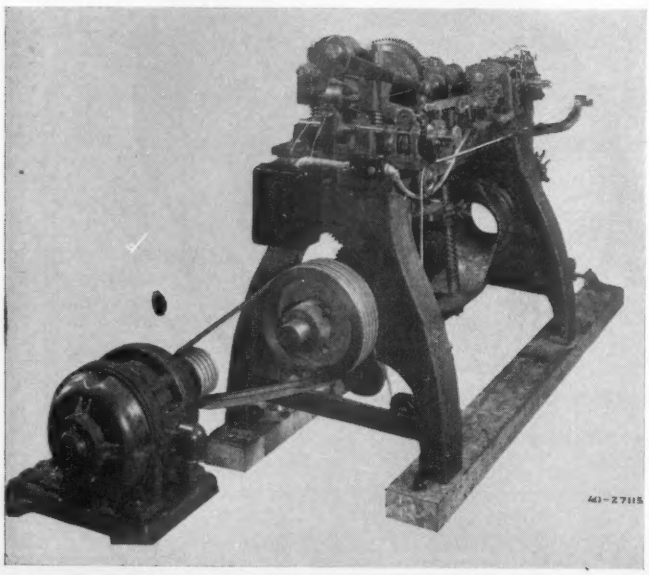

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Foreign Notes

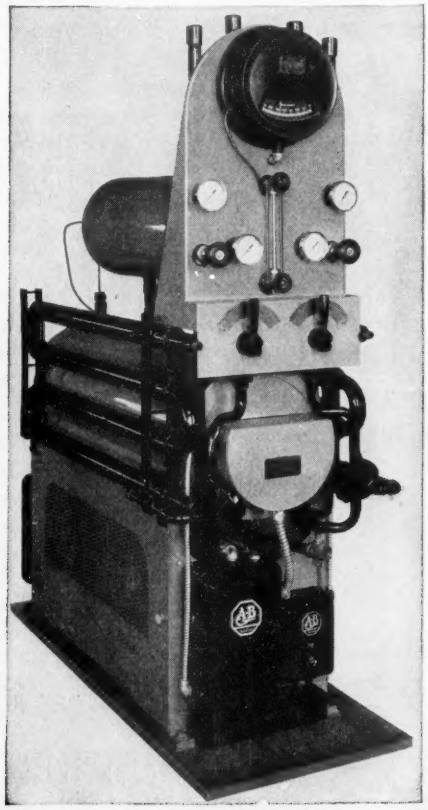
GERMAN aluminum wire production has been resumed at Singen, French Zone. The output has been planned to reach 500 tons in the second half of this year. It is probable that output will also be resumed in the British Zone soon. The European aluminum industry depends, with the exception of France, entirely on supplies of the vital raw material — bauxite, from countries which are under Russian control, particularly Hungary and Yugoslawia. The large Greek bauxite deposits in the Epirus cannot be yet utilized, as the area is still infested with guerillas. French bauxite deposits are sufficient to cover the demand of the national industry, and permit a small export surplus. The big Norwegian-Swedish, the English, Swiss, Italian, etc., industries, the German — if restarted — included, depend on South Eastern European supplies. In a case of war this may have disastrous consequences for an industry so vital.

* * *

THE demand for wire and wire products on the export market has shown signs of a revival after months of slackness. This is particularly the case in African and Asiatic markets. Pakistan has placed orders, as well as India, for baling wire, strand wire and wire netting. Barbed wire is scarce and prices are rising. Wire nails were traded at the basis of $ 112-115.; p.t. fob. From the Latin American markets, Venezuela, Peru and Bolivia were the only ones which showed an interest to buy, and most orders went to Belgium, mainly for fencing wire.

* * *

BETTER conditions of living, much better food and better pay do not only attract industrial skilled workmen for armament industries, patronized by Russia in the German-Russian Zone, but also in the wire, the bolt, rivet and similar industries. Since autumn of 1947, conditions have changed very much and the workman gets in the Russian zone now approximately 30% more food than the Bi-Zone and somewhat better pay. He works, therefore, much more, as he does not lose so much time in procuring food in the black market. The consequence is a constant stream of workmen leaving the Western Zone. Though it is most marked in the ship yard, motor car and heavy steel industries (ship construction forbidden in the Western Zones is flourishing in the Russian), the wire industry is feeling desertion of the staff, too. This has nothing to do with Communism, but to eat a bit more is so much the center of all that happens in Germany, that the Russian Zone operates like a magnet. On the other side, ten thousands of highly skilled workmen were members of the Nazi party and as such they lost their jobs and cannot work any more, except in lower-pay and general work jobs, such as road repair, moving the debris from bombed cities, street sweeping, etc. Highly skilled mechanics have been therefore either pressed to do black marketeering or execute low-pay, unskilled jobs. No wonder that they



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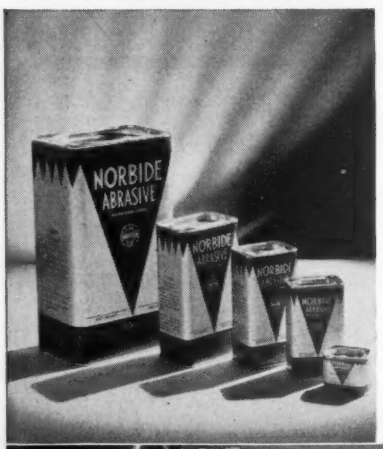

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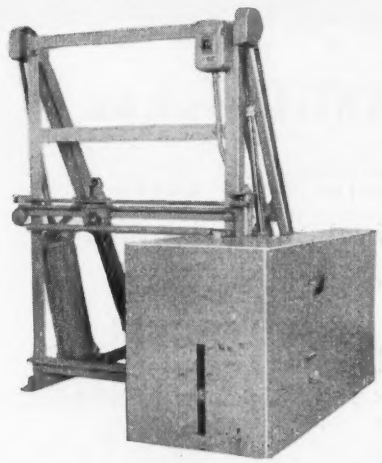

frame sizes, in 18″ to 84″ diameter reels. Traverse mechanisms are quickly and steplessly adjustable for wire size and reel width.

* * *

ALSO available as optional equipment is the JLE Slip Clutch to assure trouble-free manual or automatic torque control.

* * *

THESE Take-Up are offered in the following drives:

Motor Drive:

Constant-reel-shaft speed.

Adjustable constant-reel-shaft speed. 4 to 1 range.

Above drives with slip-clutch with or without constant-wire-tension . . . for take-up from capstan of any machine.

Adjustable constant-wire-speed, electronic or mechanical control.

Wide speed range available.

External Drive:

Driven from capstan of any machine through slip-clutch . . . with or without constant-wire-tension.

* * *

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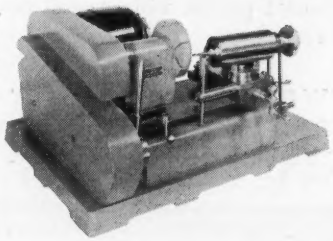
DYKREX

MACHINE CORRECTS AND REJUVENATES YOUR

DIES

to original condition



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It corrects the die by straightening out any eccentric entrance angles on the dies.

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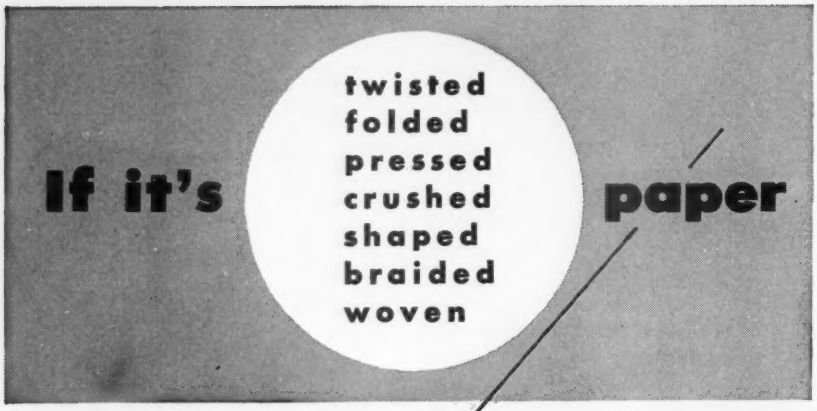

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waxed cable-filler for 2- and 3-wire non-metallic sheath cable and ship-board cable.

wire-rope cores

braiding and wrapping yarns for electrical cable.

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They are made from a specially developed grade of Tungsten Carbide having those characteristics needed for dies—freedom from porosity, great abrasion resistance and the ability to take a polish equal to that of diamonds.

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1947 Supplement to Book of A.S.T.M. Standards

TO keep up to date the triennially published Book of A. S. T. M. Standards, the American Society for Testing Materials in the intervening year issues Supplements to each part of the bock. The 1947 Supplements recently issued in five parts, give in their latest approved form some 330 specifications, tests, and definitions which were either issued for the first time in 1947 or revised since their appearance in the 1946 Book.

* * *

PART I-A on Metals, 350 pages includes 70 standards covering ferrous metals and materials, 15 of which are for spring wire. Nine relate to stainless steel, magnetic properties, and metallic coatings. There are others on steel, cast, wrought and malleable iron, boiler plate, bars, forgings, etc.

* * *

PART I-B on Nonferrous Metals. This part covering 334 pages has some 70 standards on ingot and cathode copper, copper and copper-alloy wire for electrical conductors and copper-alloy castings. There are standards on aluminum and aluminum-base alloys, magnesium and magnesium-base alloys, electrical-heating, resistance and related alloys, metal powders and products and on general testing methods.

* * *

PART II on Nonmetallic Materials (Constructional), covering 480 pages, with standards on cement and lime, brick, building stone, glass, thermal insulation, refractories, and so forth.

* * *

PART III-A on Nonmetallic Materials, has 63 standards, covering 454 pages, on the following: petroleum products and lubricants, soaps and other detergents, textile materials, water for industrial uses, industrial aromatic hydrocarbons and methods of testing.

* * *

PART III-B on Nonmetallic Materials, covering 322 pages, with some 50 standards on electrical insulating materials, plastics, on rubber, adhesives, paper and paper

products, shipping containers, thermometers and general tests.

* * *

COPIES of these 1947 Supplements can be obtained from A.S.T.M. Headquarters, 1916 Race Street, Philadelphia 3, Pa., at $4.00 per part, all five parts, $20.00. Each is bound in heavy paper cover. The five 1947 Supplements, plus the 1946 Book of Standards, give a complete set of all A.S.T.M. specifications and tests, excepting those on chemical analysis of metals which are in a special volume.

* * *

Development of "Marvinol" Traced

WARTIME research at **The Glenn L. Martin Company** which culminated in the vinyl resin Marvinol VR-10, now being shipped to tonnage lots, also resulted in 425 different plastics applications for the aircraft industry, it was revealed by **Harold H. Parsekian**, Director Sales and Technical Service of Martin's chemicals division in a speech June 8 before the Baltimore-Washington chapter, Society of The Plastics Engineers.

* * *

THE Martin Marvinol VR-10 resin was shown to have great suitability for high-temperature, high-speed processing equipment newly developed in the plastics industry.

* * *

"MAKING Marvinol begins with coal and limestone", Mr. Parsekian said, "and these are combined under terrific heat to form calcium chloride, from which acetylene is generated. For the second ingredient, an electrolysis of common table salt produces chlorine and hydrogen, yields two gases which are then combined to make hydrogen chloride. The acetylene gas and hydrogen chloride gas are then combined in contact with a catalyst to form vinyl chloride monomer liquid. When this liquid is further treated and converted into white powder it is known as Marvinol VR-10."

* * *

BESIDES its application to electric wire and cable coating, uses of the resin range from shoes to shower curtains, garden hose to

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RETURNABLE and NON-RETURNABLE

Furnished assembled or knocked down, made to your specifications. Will withstand severest handling. Sturdy, strong, low in cost. Made for

CABLE, ROPE and WIRE

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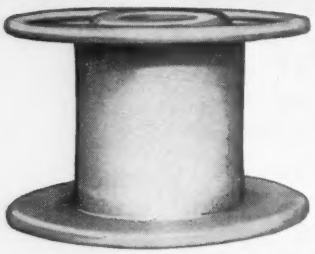

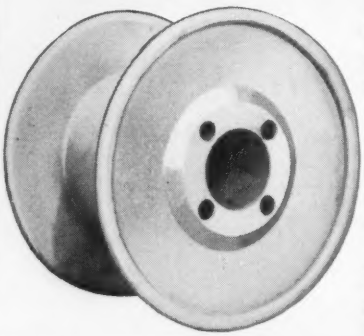

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Provides answers simply and accurately for a given mathematical wire drafting problem. One setting shows number of holes, percentage of draft per hole, total reduction in area and intermediate die sizes to be used. Universality: Because of the circular scale there are neither upper nor lower limits on the diameters that the calculator can be used for.

The Crum calculator is designed especially for wire drawing jobs involving eight or fewer drafts. Problems involving a greater number of drafts can be solved, however, with extra manipulation. For instance, if it is desired to set up a multi-draft machine to draw .0095 inch diameter wire from .0625 inch stock in sixteen drafts, the intermediate die sizes can be determined by the calculator.

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300 MAIN STREET **STAMFORD, CONN.**

floor coverings, plus hundreds of other applications.

* * *

HE traced the growth of the Martin Chemicals Division from initial research to pilot plant operations at Case School of Applied Science, Cleveland, and into the construction of the large production plant at Painesville, Ohio, geared to annual production of 25 million pounds of Marvinol. The decision to build at Painesville was based upon accessibility to special raw materials, power, transportation, fuel and water.

* * *

THE Martin Company's Vice President in charge of the Chemical Division is **Robert H. Kittner**, formerly of Cleveland.

* * *

New Book on Powder Metallurgy

A book entitled POWDER METALLURGY by Dr. Henry H. Hausner has been issued by the Chemical Publishing Company, 26 Court Street, Brooklyn 2, N. Y. This book describes the principles and methods of powder metallurgy, gives a glossary of terms, has a chapter devoted to metal powders, their production and applications, compares powder products with cast metals, and gives a number of graphs and tables that are helpful to persons concerned with this subject. It contains 298 pages and sells for $7.00.

* * *

H. R. Klepinger Retires From American Steel & Wire Company

HOWARD R. Klepinger, superintendent of special assignments for **American Steel & Wire Company,** United States Steel Corp'n subsidiary, is retiring after more than 30 years of service with the company.

* * *

Sylvania Electric Products, Inc. Appointment

J. C. Farley has been appointed general manager, Radio Division, **Sylvania Electric Products, Inc.,** New York. He formerly had been controller of the Radio Division. His association with Sylvania Electric and predecessor companies began in 1922.

Pacific Coast Regional Meeting of the Wire Association

(*Continued from page 594*)

DOLEMAN, EDWARD, Met.
Columbia Steel Company
Pittsburg, California
EGAN, JOHN W., Sales
Bethlehem Pacific Coast Steel Co.
Los Angeles, California
EICKELMAN, E., Met.
Colorado Fuel & Iron Company
Pueblo, Colorado
ENSLOW, LAWRENCE C., Salesman
California Wire Cloth Corp.,
San Francisco, California
GILL, S. S., Met.
K. H. Davis Wire & Cable Corp.
Los Angeles, California
HALEY, W. T., Asst. Secy.
Wildberg Bros. Smelting & Refining Co.
San Francisco, California
HANSEN, FRED W., Asst. Sales Mgr.
California Wire Cloth Corp.
Oakland, California
HARPER, W. A., Plant Prod. Mgr.
E. H. Edwards Company
South San Francisco, California
HEAVRIN, GEORGE, Asst. Mgr.
California Spring Company
Los Angeles, California
HASSEL, E. W., Sales Engr.
Crucible Steel Company of America
San Francisco, California
HAWLEY, JOHN S., Mgr.
California Wire Cloth Corp.
Oakland, California
HENDRICK, R. F., Purch. Agent
E. H. Edwards Company
San Francisco, California
HIGHRITER, HARRY W., Tech. Dir.
Vascoloy Ramet Corp.
North Chicago, Illinois
HOUSTON, GEORGE H., Pur. Agent
Simmons Company
San Francisco, California
HUNTER, OSCAR, S. F. Branch Salesman
Owens Corning Fiberglas Corp.
Toledo, Ohio
JASON, HARRY H., Sales & Service Engr.
Carboloy Company, Inc.
Oakland, California
JENSEN, CLYDE L., Foreman
California Wire Cloth Corp.
South San Francisco, California
JOSEPH, J. L., Foreman
Wildberg Bros. Smelting & Refining Co.
San Francisco, California
KILLIAN, G. L., Owner
Acme Wire & Steel Company
Los Angeles, California
KINYIN, E. C., Division Supt, W & W P
Columbia Steel Company
Pittsburg, California
KIRCHNER, H. W., Industrial Furnace Engr.
Natural Gas Equipment, Inc.
San Francisco, California
KUSBER, JOSEPH, Partner
Kusber Brothers
Daly City, California
KUSBER, LEO, Partner
Kusber Brothers
Daly City, California
LIND, RAYMOND O., Plant Engr.
E. H. Edwards Company
South San Francisco, California
LUHRS, A. F., Supt.
K. H. Davis Wire & Cable Corp.
Los Angeles, California
MACK, RAY D., Dist. Mgr.
Carboloy Company, Inc.
Los Angeles, California
MACKESY, JOHN, Sales
Oakite Products, Inc.
Oakland, California
MC CALL, J. D., Gen. Supt.
Columbia Steel Company
Pittsburg, California
MC CLOSKEY, C. P., Supvr. Customer Service
Pacific Tube Company
Los Angeles, California
MC JIMSEY, R. L., Mgr.
Drake Steel Supply Company
Fresno, California
MEHL, C. R., retired
MERRELL, R. T., Supt. Wire Mill
Columbia Steel Company
Pittsburg, California
MIGGE, EDWIN H., Foreman
California Wire Cloth Company
South San Fdancisco, California
MIHOLICH, JOSEPH L., Supt.
General Electric Company
San Francisco, California
MOHR, WM., Supt.
California Wire Cloth Corp.
South San Francisco, California
MOON, P. D., Shipping Dept.
Industrial Wire Products Corp.
San Francisco, California
MORRIS, G. L., Vice Pres.
Syncro Machine Company
Perth Amboy, N. J.
MORRISS, JAMES C., JR., Plant Engr.
Aluminum Company of America
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THE 1948 ANNUAL CONVENTION

will be held in Pittsburgh, Pa., at the

WILLIAM PENN HOTEL

October 18th through the 22nd.

Please note that the Convention will occupy five full days this year, instead of four, as heretofore. Enter these dates on your calendar now and plan to attend the big meeting

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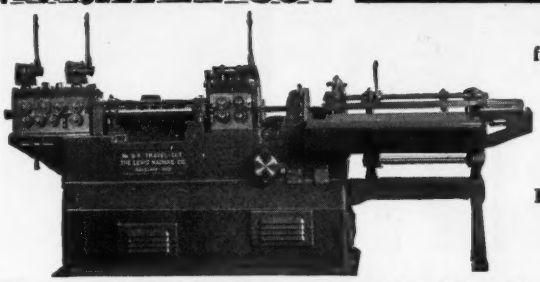

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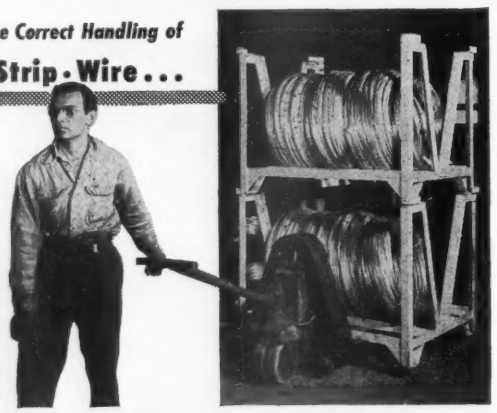

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OLSON, ALBERT A., Wire Mill Supt.
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Los Angeles, California
PARKHURST, J. W., Dist. Mgr.
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Oakland, California
PHELPS, ROBERT L., Salesman
California Wire Cloth Corp.
South San Francisco, California
POTTER, E. R., Vice Pres.
Industrial Wire Products Corp.
Los Angeles, California
PRINDLE, ROY, Gen. Foreman Nut & Bolt Div.
Bethlehem Pacific Coast Steel Company
South San Francisco, California
PROELSS, O. A., Supv. of Met.
Columbia Steel Company
Pittsburg, California
RENNECKAR, L. F., Sales Dept.
Republic Steel Corp.
Los Angeles, California
REYNOLDS, J. MORTON, Foreman
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South San Francisco, California
RICE, DON, Asst. Gen. Supt.
Columbia Steel Company
Pittsburg, California
ROELOP, ARTHUR A., Sales Manager
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Los Angeles, Califodnia
ROSE, RUSSELL O., Master Mechanic
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RUNGA, OTTO, Owner
Ferric Products Company
Oakland, California
SCHRAUB, FRED L., Vice Pres.
Wire Specialties Company
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SCHROEDER, JACK F., Salesman
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SCHULZ, RICHARD O., Supt.
California Spring Company
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SMITH, GEO. L., Sales Engr.
Kraftile Company
Niles, California
SMITH, KENNETH, Asst. to Pres.
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San Francisco, California
SOMME, W. H., Pres.
Wire Specialties Company
Santa Clara, California
SOMMER, MILLARD, Secy. Treas.
Wire Specialties Company
Santa Clara, California
SONNAR, J. S., Mgr.
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E. H. Edwards Company
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Western Steel & Wire Company
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STEPHENSON, S., Mgr. Wire Products Sales
Bethlehem Pacific Coast Steel Corp.
San Francisco, California
STOOKEY, E. B., Plant Supt.
E. H. Edwards Company
South San Francisco, California
STAPLETON, C. PERRY, Salesman
Republic Steel Corp.
Los Angeles, California
SULLIVAN, C. L., Foreman
California Wire Cloth Corp.
South San Francisco, California
TREMBICKI, HAROLD, Mgr. Metal Coating Div.
Magnus Chemical Company
Garwood, N. J.
TURNER, D. P., Foreman
California Wire Cloth Corp.
South San Francisco, California
UNDERWOOD, E. S., Met. Engr.
Bethlehem Pacific Coast Steel Corp.
Los Angeles, California
VON PLANCK, C. L., Chief Metallurgist
Columbia Steel Company
San Francisco, California
VOSS, FRANK, Office Mgr.
Industrial Wire Products Corp.
Los Angeles, California
WARNER, S. D., Supt. Nail Mill
Columbia Steel Company
Pittsburg, California
WATKINS, BLAIR, Salesman
Pacific Coast Borax Company
San Francisco, California
WEIR, WILLIAM, Supt.
Wildberg Brothers Smelting & Refining Co.
South San Francisco, California
WEST, E. M., Dist. Sales Mgr.
Ludlow Saylor Wire Company
St. Louis, Missouri
WILDBERG, IRVING I., Pres.
Wildberg Brothers Smelting & Refining Co.
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WILDE, DONALD C., Met.
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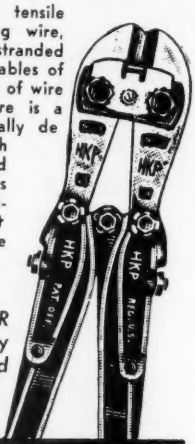
For cutting high tensile strength wire, spring wire, hard wire rope, stranded guy wire, tie wire, cables of all kinds — any kind of wire hard or soft — there is a Porter Cutter specially designed to do each job faster, easier and safer. Porter Cutters are practically standard equipment throughout the entire wire industry.



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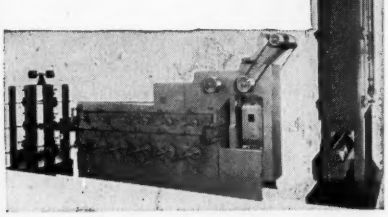

WILLIAMS, R. E., Supt. Prod. Planning
Columbia Steel Company
Pittsburg, California

WOOD, J. C., Supt. Wire Mill
Columbia Steel Company
Pittsburg, California

WUNDERLEICH, JOHN W., Dept. Metallurgist
Columbia Steel Company
Pittsburg, California

YARNOLD, GEORGE E., Supt., U.D.S. Division
Republic Steel Corp.
Los Angeles, California

* * *

Institute of Metals Medal for 1948 Presented to Robert C. Stanley, Chairman and President of The International Nickel Company of Canada, Ltd.

THE President and Council of the Institute of Metals gave a dinner party at the Savoy Hotel, London, on Wesdnesday, May 26, in honour of **Robert C. Stanley**, Chairman and President of the International Nickel Company of Canada, Ltd., and Dr. **Paul D. Merica**, Vice-President of the International Nickel Company. Sir Arthur Smout, President, was in the Chair.

* * *

DURING the evening Sir Arthur Smout presented to Mr. Stanley the Institute of Metals (Platinum) Medal for 1948, awarded to him in recognition of his outstanding services to the non-ferrous metal industries.

* * *

Gaspar Joins American Machine and Metals

C. **J. Gasper** resigned his position as Assistant Sales Manager of the Nichols Wire and Aluminum Company, Davenport, Iowa, recently to take up his new duties as Sales Manager of the DeBothezat Fans Division of the American Machine and Metals Company of East Moline, Ill.

* * *

Hayes Adds to Staff

C. **I. Hayes, Inc.**, 75 Baker St., Providence, R. I., announce the appointment of **Leonard J. Edwards**, with headquarters at the above address, as New England sales representative for their line of industrial electric heat treating and hardening furnaces. Mr. Edwards was for many years, field Sales Manager for General Alloys Co. of Boston, Mass.

TWO Ways to get More Tons at LESS Cost

1. Use Oakite Pickle Control No. 3 to save acid, save steel, cut baking time, make pickling solutions last longer.
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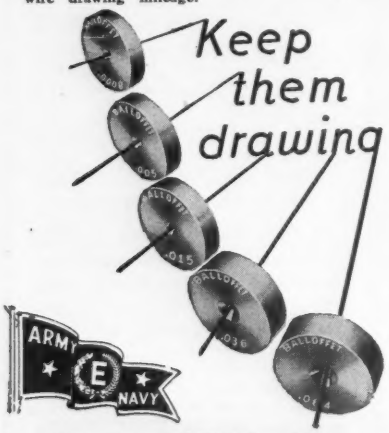

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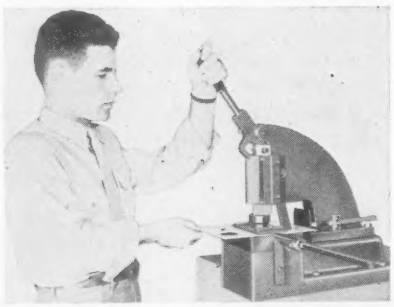

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* * *

COMPLETE information covering the new DI-ACRO Punch is contained in the 40-page DI-ACRO Catalog and this will be mailed gratis to your readers upon request to **O'Neil-Irwin Mfg. Co.**, 303 Eighth Ave., Lake City, Minn.

* * *

New Bulletin

THIS bulletin describes and illustrates Baldwin-Tate-Emery Universal Testing Machine Models 20-35 and 60-35 with respective capacities of 20,000 and 60,000 lb. These machines apply and measure loads hydraulically using precision lapped-ram construction in conjunction with 3-range Tate-Emery Null Method Dial Indicators. The bulletin describes the principles of operation, the accessories, and gives specifications. Copies are available from The Baldwin Locomotive Works, Testing Equipment Department, Philadelphia 42, Pa. Ask for Bulletin No. 282.

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Metal Carbides Corporation's Revised Tool Catalog

METAL Carbides Corporation, Youngstown, Ohio, announces publication of a revised Tool Catalog 48-T covering Talide Tungsten Carbide Tools and Tips. This catalog incorporates the new standard identification numbers recently adopted by the carbide industry. Also included are several new styles and sizes of cutting tools and tips. For a copy of this catalog, address Metal Carbides Corporation, Youngstown, Ohio.

* * *

J. & L. Modernizes Wire Mill

(*Continued from page* 582)

15 per cent. The current capacity of the nail mill is 85,000 kegs a month, bright galvanized, blued and coated.

* * *

Blueing Facilities

INSTALLATION of modern blueing equipment is underway. The process consists of dumping a keg of nails into a hopper which spills the nails onto a metal mesh conveyor. The conveyor feeds the nails through a furnace where they are heated to about 800 degrees Fahrenheit, giving them a blue finish. After heating and cooling, the nails are spilled back into kegs and weighed.

* * *

Palletization Program

UNDER the palletization program in the nail mill, all nails will be stored in 100-lb. kegs on 32 keg pallets, piled eight high. Lift trucks will stack the pallets and load the pallets onto freight cars for shipment.

* * *

Conclusion

TO successfully meet demand for high quality wire products in a "wire hungry" world, continuous expansions and improvements in production facilities are a necessity.

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ONE hundred years ago the average use of wire per American home amounted to only about three ounces. Today, the average size house may have in it hundreds of pounds of wire, including — wire nails, wire lath, wire for electricity, wire trays in the refrigerator, wire springs in the clocks, window screens, fire place screens, picture wire, birdcage wire, wire coat hangers and hooks, wire springs in mattresses and upholstered furniture, wire mouse traps, bucket handles, piano wire, bobby pins, hair pins, safety pins, shower curtain hooks, wire racks in the stove, wire bread holders in the electric toaster, pipe cleaners, knitting needles, wire on the broom, and many more uses — new uses are being developed daily.

* * *

Spring Design and Manufacture
Part II

(*Continued from page* 588)

THE lathe is equipped with two lead shafts and two cam shafts. The top lead shaft controls the open coils and the bottom shaft controls the close coils.

* * *

BOTH shafts are operated by worm and wheel and are clutch operated, similar to the lathe tripping clutch. A rocker arm connects the two lead shafts, thus, when the lathe is coiling open coils, the top lead shaft is in operation, the rocker having operated the clutch mechanism, leaving the bottom shaft free. When the correct number of open coils have been made, the rocker arm, which is cam operated, disengages from the top lead shaft clutch and operates the botom lead shaft, thus forming the close coils.

* * *

AFTER the close coils have been made, the rocker transfers to the top lead shaft and so on until a length of approximately five feet of springs are coiled, which are then withdrawn from the mandrel to be cut into individual springs later.

* * *

BOTH the top and bottom lead shafts are controlled by gear boxes to obtain the necessary pitch.

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IN the fourth group we come to Automatic Coiling. Essentially, the operation of an automatic spring coiling machine, consists of pushing the correct length of wire by means of friction rollers, through confining guides over a stationary arbor against deflecting tools, usually called "coiling pins", into a coil.

* * *

THE arbor is out on the end to form an anvil to sever the completed springs from the incoming wire. Springs can be coiled either Left Hand or Right Hand and can be close coiled or open pitch.

* * *

THE pitch of the spring is controlled by the act of the coiling pins and a cam operated vee shaped spacer. The diameter of the spring is varied by adjustment to the coiling pins.

* * *

VARIOUS shapes of springs can be obtained by introduction of cam plates, which automatically open and close the coiling pins to the desired shape.

* * *

AFTER the spring is cut off, the first part of the coil for the following spring, is left in position in the coiling pins to obtain an easy start.

* * *

THE wire length is controlled through gears to a clutch which is automatically braked when the correct length of wire has passed through the rollers.

* * *

Gauging

THE next step in the manufacture, is the gauging of all individual springs to length, and then, the springs are heat treated in Electric furnaces to relieve the coiling stresses. The temperature varies with different springs, and different types of steel.

* * *

AFTER heat treatment the springs are ground both ends to ensure square seating. Automatic machines are used for this process which grind both ends at the same time and thus ensures that all springs are equal in length.

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THEN comes the "Scragging" operation, which means that the springs are compressed solid a number of times to remove any set that may be present.

* * *

INSPECTION follows and the springs are checked dimensionally and tested for load and deflection against the requirements laid down on the print or order.

* * *

AFTER Inspection the springs are given various finishes in accordance with the requirements. The finishes include, Cadmium, Nickel, Chromium, Copper and Zinc Plating. Various coloured Enamels, Coslettised, Chemag, Etc.

* * *

THIS brief description applies to springs manufactured from hard drawn and patented wire. Of course, springs are manufactured from annealed steel and from alloy steels, that is, Silicon Manganese, Chrome Vanadium and Silicon Chrome steels. These steels require hardening by quenching from a temperature of anything between 780° and 1000° centigrade in oil. After hardening they are tempered in the same manner as already described. The other processes closely follow those which are used in the case of hard drawn wire.

* * *

THE technique of spring design and manufacture has undergone a considerable change during the past twenty years and in light of present research, and the interest of the engineering world as a whole, one can confidently expect further advancement in all directions in the future.

* * *

IN this paper I have used many technical terms and described briefly, various practical methods, but the highest quality spring necessitates long years of practical experience and scientific knowledge.

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Magnus Chemical Co., Garwood, N. J.
Metal & Thermit Corp., New York, N. Y.
Nopco Chemical Co., Harrison N. J.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

CLEANING & PICKLING EQUIP.—
Cleveland Tramrail Div., of the Cleveland Crane & Engineering Co., Wickliffe, O.
Haveg Corp., Newark, Del.
Metal & Thermit Corp., New York, N. Y.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

CLOTH TESTERS—
Scott Testers, Inc., Providence, R. I.

CLOTH—WIRE, All Metals
Roebling's, John A. Sons, Co., Trenton, N. J.
Wickwire Spencer Steel Division, Colorado Fuel & Iron Corp., Buffalo, N. Y.

COATING COMPOUNDS—
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

COILERS—Sheet, Strip and Wire
Entwistle, Jas. L. Co., Pawtucket, R. I.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J. Machine Co., Newark, N. J.
Wean Equipment Corp., Cleveland, Ohio.

COLD HEADERS—
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

COMPOUNDS—Coppering
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Diamond
Magnus Chemical Co., Garwood, N. J.
Engis Equipment Co., Chicago, Ill.

COMPOUNDS—Metal Finishing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.

COMPOUNDS—Rust Preventing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Nopco Chemical Co., Harrison N. J.
Oakite Products, Inc., New York, N. Y.

COMPOUNDS—Rust Removing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

COMPOUNDS—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Bick, Hans C., Inc., Reading, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H. Co., Inc., Homer, N. Y.
Nopco Chemical Co., Harrison N. J.
Oakite Products, Inc., New York, N. Y.
Pacific Coast Borax Corp., New York, N. Y.
Potter, Neil C., Newark, N. J.
Standard Industrial Compounds Co., Chicago, Ill.
Swift & Company, Chicago, Ill.

COPHOLDERS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Wire & Textile Machinery Inc., Pawtucket, R.I.

CRANES—Wire Mill
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CUTTING TOOLS—Carbide
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel & Carbide Co., McKeesport, Pa.
Metal Carbides Corporation, Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, New York.
Vascoloy-Ramet Corp., North Chicago, Ill.
Willey's Carbide Tool Co., Detroit, Mich.

CUTTING TOOLS—Wire
Porter, H. K., Inc., Everett, Mass.

DIAMONDS—Industrial
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N.J.
Champion Diamond Co., New York, N. Y.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND POWDERS—
Champion Diamond Co., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND TOOLS—
Carboloy Co., Inc., Detroit, Mich.
Eastern Tungsten Carbide Co., Newark, N. J.
Firth Sterling Steel & Carbide Co., McKeesport, Pa.
Metal Carbides Corporation, Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Wayne Wire Die Co., Hillside, N. J.

DIES—Cold Heading
Hoosier Carbide Die Co., Ft. Wayne, Ind.

DIES—Diamond
Ajax Industrial Supplies, Inc., Fort Wayne, Ind
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N.J.
Cochaud Wire Die Corp., New York, N. Y.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIES—Eyelet
Hoosier Carbide Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.

DIES—Lead Extrusion
Carboloy Co., Inc., Detroit, Mich.
Eastern Tungsten Carbide Co., Newark, N. J.
Firth Sterling Steel & Carbide Co., McKeesport, Pa.
Metal Carbides Corporation, Youngstown, Ohio.
Robertson, John, Co., Brooklyn, N. Y.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Repairs & Re-Cutting
Ajax Industrial Supplies Inc., Fort Wayne, Ind.
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N.J.
Carboloy Co., Detroit, Mich.
Cochaud Wire Die Corp., New York, N. Y.
Eastern Tungsten Carbide Co., Newark, N. J.
Firth-Sterling Steel & Carbide Co., McKeesport, Pa.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Rod and Tube Drawing
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N.J.
Carboloy Co., Inc., Detroit, Mich.
Eastern Tungsten Carbide Co., Newark, N. J.
Firth-Sterling Steel & Carbide Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Sintered Carbide
Hoosier Carbide Die Co., Ft. Wayne, Ind.

DIES—Special Shapes, Etc.
Hoosier Carbide Die Co., Ft. Wayne, Ind.

DIES—Tantalum Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N.J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel & Carbide Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.

DIES—Tubing
Hoosier Carbide Die Co., Ft. Wayne, Ind.

DIES—Tungsten Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N.J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel & Carbide Co., McKeesport, Pa.
Hoosier Carbide Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, Ohio.
Rusch Wire Die Corp. Croton-on-the-Hudson, N.Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DRAW BENCHES—
(See MACHINERY—Draw Benches)

DRUMS—Flange Steel
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.

DRUMS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.
Watson Machine Co., The, Paterson, N. J.

DRYING EQUIPMENT—
Carl-Mayer Corp., The, Cleveland, Ohio.
Industrial Ovens, Inc., Cleveland, Ohio.
Ross, J. O., Engineering Corp., New York, N.Y.

WHERE TO BUY, Continued

ENGINEERS—Consulting Wire Mill
Lewis, Kenneth B., Worcester, Mass.

EQUIPMENT—Insulation Testing
Davis, R. L., Elec. Co., Wallingford, Conn.
Entwistle, James L., Co., Pawtucket, R. I.

EYELETS—Brass or Zinc
Platt Bros., & Co., The, Waterbury, Conn.

FLUXES—Soldering
American Chemical Paint Co., Ambler, Pa.

FOAM PRODUCING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Parkin, Wm. M. Co., Pittsburgh, Pa.

FRICTION PAY-OFF STANDS—
Industrial Ovens, Inc., Cleveland, Ohio.

FURNACES—Annealing
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Hayes C. I., Providence, R. I.
Morrison Engineering Corp., Cleveland, Ohio.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engr. Co., Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Automatic
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Brazing
Electric Furnace Co., Salem, Ohio.
Firth-Sterling Steel & Carbide Co., McKeesport, Pa.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, Ohio.
Furnace Engineers Inc., Pittsburgh, Pa.
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Electric
Eisler Engineering Co., Newark, N. J.
Electric Furnace Co., Salem, Ohio.
Hayes, C. I., Providence, R. I.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engineering Co., The, Cleveland, Ohio

FURNACES—Galvanizing Equipment
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engineering Co., The, Cleveland, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Hard'ing & Temp'ing
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engr. Co., The, Cleveland, Ohio.

FURNACES—Lead Melting
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Robertson, John, Co., Brooklyn, N. Y.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Non-Oxidizing
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Normalizing
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Pot (Oil, Gas, Electric)
Ajax Electric Co., Inc., Philadelphia, Pa.

FURNACES—Resistance Healing, Strand
Trauwood Engineering Co., Cleveland, Ohio

FURNACES—Salt Bath
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio.
Surface Combustion Corporation, Toledo, O.
Trauwood Engineering Co., The, Cleveland, Ohio

FURNACES—Wire, Strip & Sheet
Carl-Mayer Corp., The, Cleveland, Ohio.
Eisler Engineering Co., Newark, N. J.
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Surface Combustion Corporation, Toledo, O.
Trauwood Engineering Co., The, Cleveland, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio.

GALVANIZING ENGINEER—Consulting
Spowers, W. H., Jr., New York, N. Y.

GALVANIZING EQUIPMENT—
Hanson-Van Winkle-Munning Co., Matawan, N.J.
Steel Equipment Co., Cleveland, Ohio.
Wean Equipment Corp., Cleveland, Ohio.

GAVANIZING FLUXES—
Hanson-Van Winkle-Munning Co., Matawan, N.J.

GALVANIZING KETTLES—
National Annealing Box Co., Washington, Penna.

GRINDERS—Roll
Norton Co., The, Worcester, Mass.

HOISTS—Electric Travelling
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, Ohio.

INHIBITORS—Pickling
American Chemical Paint Co., Ambler, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M. Co., Pittsburgh, Pa.

INSULATING LACQUERING SYSTEMS—Continuous
American Insulating Machine Co., Phila., Pa.
Industrial Ovens, Inc., Cleveland, Ohio.

INSULATING MATERIALS—
Du Pont de Nemours, E. I., Co., Wilmington, Del.
General Electric Co., Schenectady, N. Y.
Martin, Glenn L. Company, Baltimore, Md.
Owens Corning Fiberglas Corp., Toledo, O.
Standard Varnish Wks., Staten Island, N. Y.
Twitchell, E. W., Philadelphia, Pa.
Warren Thread Works, Inc., W., New York, N.Y.

LATHES—Die Reaming
Carboloy Co., Inc., Detroit, Mich.
Firth Sterling Steel & Carbide Co., McKeesport, Pa.
Morgan Construction Co., Worcester, Mass.
Roos, H. & G., Tool & Mfg. Co., Montclair, N.J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

LIME—
Warner Co., Philadelphia and Bellefonte, Pa.

LININGS—Acid and Alkali Proof
Haveg Corp., Newark, Del.
Sauereisen Cements Co., Pittsburgh, Pa.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

LUBRICANTS—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Bick, Hans C., Inc., Reading, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Potter, Neil C., Newark, N. J.
Standard Industrial Compounds Co., Chicago, Ill.
Swift & Company, Chicago, Ill.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Barbed Wire
Reed & Richards Transatlantic Co., Inc., New York, N. Y.

MACHINERY—Braiding
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Wire & Textile Mach'y, Inc., Pawtucket, R. I.

MACHINERY—Brazing
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Bunching
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Cable, Electric
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Chain Making
Nilson, A. H. Machine Co., The, Bridgeport, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Cable, Rope Closing
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coil Winding
Entwistle, Jas. L. Co., Pawtucket, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Collers
Eisler Engineering Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (used), New York, N. Y.
New England Butt Co., Providence, R. I.
Ruesch, H. J. Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio.
Wire & Textile Machinery Inc., Pawtucket, R. I.

MACHINERY—Copper Wire Drawing and Rolling
Aetna Standard Eng'g Co., The, Youngstown, O.
American Insulating Mach'y Co., Phila., Pa.
National Machinery Exchange (used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Covering Wire
American Insulating Mach'y Co., Phila., Pa.
National Erie Corp., Erie, Pa.
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cutting
Eisler Engineering Co., Newark, N. J.
Lewis Machine Co., The, Cleveland, Ohio.
National Mach'y Exch. (Used), New York, N.Y.
Nilson Machine Co., A. H., Bridgeport, Conn.
Porter, H. K. Inc., Everett, Mass.
Reed & Richards Transatlantic Co., Inc., New York, N. Y.
Shuster, F. B. Mfg. Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Die Making
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel & Carbide Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Roos, H. & G., Tool & Mfg. Co., Montclair, N.J.
Wayne Wire Die Co., Hillside, N. J.

MACHINERY—Draw Benches
Aetna Standard Eng'g Co., The, Youngstown, O.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Edging
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.
Industrial Ovens, Inc., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.

WHERE TO BUY, Continued

MACHINERY—Extruding
National Erie Corp., Erie, Pa.
Robertson John, Co., Brooklyn, N. Y.
Royle, John, & Sons, Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R. .I

MACHINERY—Fence
Glader, Wm., Machine Works, Chicago, Ill.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Filament Coil Winding
Eisler Engineering Co., Newark, N. J.

MACHINERY—Flat Wire
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Galvanizing
(See Galvanizing Equipment)

MACHINERY—Galvanizing Wire
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

MACHINERY—Gang Winders
Entwistle, Jas. L. Co., Pawtucket, R. I.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., The, Worcester, Mass.

MACHINERY—Insulating
American Insulating Mach'y Co., Phila., Pa.
National Erie Corp., Erie, Pa.
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lead Encasing Presses, etc.
Robertson, John Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
Robertson, John Co., Brooklyn, N. Y.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Material Handling
Cleveland Tramrail, Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.
Fab-Weld Corporation, Philadelphia, Pa.

MACHINERY—Measuring Wire & Cable
Durant Mfg. Co., Milwaukee, Wis.
Entwistle, Jas. L. Co., Pawtucket, R. I.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works, Chicago, Ill.
National Mach'y Exch. (Used), New York, N.Y.
Reed & Richards Transatlantic Co., Inc., New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Panning
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Perth Amboy, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Plating Electrolytic
Hanson-Van Winkle-Munning Co., Matawan, N.J.

MACHINERY—Pointing
Aetna Standard Eng'g Co., The, Youngstown, O.
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry & Mach. Co., Trenton, N.J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MATERIAL—Resistance Heating Strand
Trauwood Engineering Co., Cleveland, Ohio.

MACHINERY—Rod Mill
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Rolling Mill
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Rubber Insulating
Royle, John & Sons, Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R. I.

MACHINERY—Rubber Tubing and Straining
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Screw Wire
National Mach'y Exch. (Used), New York, N.Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila., Pa.
Emory, Robert J., Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
National Erie Corporation, Erie, Pa.
New England Butt Co., Providence, R. I.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry & Mach. Co., Trenton, N.J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Spooling
American Insulating Mach'y Co., Phila., Pa.
Eisler Engineering Co., Newark, N. J.
Emory, Robert J., Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
National Mach'y Exch. (Used), New York, N.Y.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O. Waterbury, Conn.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio.
Wire & Textile Mach'y, Inc., Pawtucket, R. I.

MACHINERY—Spring Making
National Mach'y Exch. (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Staple
Reed & Richards Transatlantic Co., Inc., New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINFRY—Steel Bale Ties
Reed & Richards Transatlantic Co., Inc., New York, N. Y.

MACHINERY—Straightening
Lewis Machine Co., The, Cleveland, Ohio.
National Mach'y Exch. (Used), New York, N.Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Reed & Richards Transatlantic Co., Inc., New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Shuster, F. B., Mfg. Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Stranding
Hughesville Machine & Tool Co., Hughesville, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Ruesch, H. J., Machine Co., Newark, N. J.
Steel Equipment Co., Cleveland, Ohio.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Swaging
National Erie Corp., Erie, Pa.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Testing Physical
American Optical Co., Buffalo, N. Y.
Scott Testers, Inc., Providence, R. I.

MACHINERY—Testing Equipment—Sparkers
Davis, R. L. Elec. Co., Wallingford, Conn.
Entwistle, Jas. L., Pawtucket, R. I.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Tinning Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Steel Equipment Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila, Pa.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
National Erie Corp., Erie, Pa.
Ruesch, H. J., Machine Co., Newark, N. J.

MACHINERY—Welding Wire
Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago, Ill.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Winding
American Insulating Mach'y Co., Phila, Pa.
Eisler Engineering Co., Newark, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wind-up (Constant Tension, Variable Speed)
Aetna Standard Eng'g Co., The, Youngstown, O.
Industrial Ovens, Inc., Cleveland, Ohio.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Bending
Eisler Engineering Co., Newark, N. J.
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

MACHINERY—Wire Drawing
Aetna Standard Eng'g Co., The, Youngstown, O.
American Insulating Mach'y Co., Phila., Pa.
Eisler Engineering Co., Newark, N. J.
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Wire Forming
Eisler Engineering Co., Newark, N. J.
National Mach'y Exch. (Used), New York, N.Y.
Nilson Machine Co., A. H., Bridgeport, Conn.
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.
Reed & Richards, Transatlantic, Inc., New York,
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Wire Pullers and Wedge Grips
Morgan Construction Co., Worcester, Mass.
Scudder, E. J. Fdy & Mach. Co., Trenton, N.J.
Sjogren Tool & Machine Co., Inc., Auburn, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wood Screw
National Mach'y Exch. (Used), New York, N.Y.

MACHINERY—Wraping Wire Coils
Angier Corporation, Framingham, Mass.

MATERIAL HANDLING EQUIPMENT
Cleveland Tramrail, Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.
Fab-Weld Corporation, Philadelphia, Pa.

NAILS—Wire
American Steel & Wire Co., Cleveland, Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling, John A. Sons Co., Trenton, N. J.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.
U. S. Steel Export Co., New York, N. Y.

NAIL DIE GRINDERS
Reed & Richards Transatlantic Co., Inc., New York, N. Y.

WHERE TO BUY, Continued

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Chase Brass & Copper Co., Waterbury, Conn.
Eastwood-Nealley Corp., Belleville, N. J.
Hudson Wire Co., Ossining, N. Y.

OPTICAL EQUIPMENT—Metallurgical
American Optical Co., Buffalo, N. Y.

OVENS—Cable Lacquering
American Insulating Mach'y Co., Phila., Pa.
Industrial Ovens, Inc., Cleveland, Ohio.

OVENS—Dehydrogenizing
Carl-Mayer Corp., The, Cleveland, Ohio.
Industrial Ovens, Inc., Cleveland, Ohio.

OVENS—Industrial
Carl-Mayer Corp., The, Cleveland, Ohio.
Industrial Ovens, Inc., Cleveland, Ohio.
Ross, J. O., Engr. Corp., New York, N. Y.

OVENS—Welding Rod Coating
Carl-Mayer Corp., The, Cleveland, Ohio
Industrial Ovens, Inc., Cleveland, Ohio.
Ross, J. O., Engr. Corp., New York, N. Y.

PAINTS—Heat Resisting
American Chemical Paint Co., Ambler, Pa.

PANS—Lead and Spelter
National Annealing Box Co., Washington, Penna.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

PAPER—Creped Wrapping
Crepe-Kraft Co., Newark, N. J.

PAPER—For Coil Wrapping and Corrosion Prevention
Crepe-Kraft Co., Newark, N. J.

PAPER TESTERS—
Scott Testers, Inc., Providence, R. I.

PATENT ATTORNEYS—
Lancaster, Allwine and Rommel, Washington, D.C.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M., Co., Pittsburgh, Pa.

PICKLING—Hooks, etc. Acid Resisting
Gordon, Clark E., Detroit, Mich.

PICKLING TANK LININGS—
Haveg Corp., Newark, Del.
Sauereisen Cements Co., Pittsburgh, Pa.

PIPES & FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

PLASTIC TESTERS—
Scott Testers, Inc., Providence, R. I.

PLATING PROCESS—Electrolytic
Hanson-Van Winkle-Munning Co., Matawan, N.J.

POTS—Lacquer
Industrial Ovens, Inc., Cleveland, Ohio

POTS—Lead Melting
National Annealing Box Co., Washington, Pa.
Robertson, John, Co., Brooklyn, N. Y.

POWDER—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Potter, Neil C., Newark, N. J.
Standard Industrial Compounds Co., Chicago, Ill.

PRESSES—Hydraulic and Mechanical
Robertson, John, Co., Brooklyn, N. Y.

PRESSES—Lead
Robertson, John, Co., Brooklyn, N. Y.

PRESSURE VESSELS—
National Annealing Box Co., Washington, Penna.

PULLERS—Wire
Scudder, E. J., Fdry. & Mach. Co., Trenton, N.J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
Robertson, John, Co., Brooklyn, N. Y.

REEL AND TENSION STANDS—
Davis, R. L. Electric Co., Wallingford, Conn.
Entwistle, James L., Co., Pawtucket, R. I.
Industrial Ovens, Inc., Cleveland, Ohio.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS—Annealing and Stranding
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Collapsible
Entwistle, Jas. L. Co., Pawtucket, R. I.

REELS—Steel
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS AND SPOOLS—Shipping and Shop
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg., Co., The, Hazardville, Conn.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Takeoff
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., Hazardville, Conn.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B., Mfg. Co., New Haven, Conn.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Vulcanizing & Impregnating
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Wire Drawing
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Wire Mill
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., Hazardville, Conn.
Durkee Mfg. Co., Pine River, Minn.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B., Mfg. Co., New Haven, Conn.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Wooden
Bridge Mfg. Co., Inc., The, Hazardville, Conn.
Durkee Mfg. Co., Pine River, Minn.

REFRACTORIES—High Temperature
Norton Company, Worcester, Mass.

RESISTANCE HEATING—Annealing, Patenting, Etc.
Trauwood Engr. Co., Cleveland, Ohio.

ROD BAKERS—
Carl-Mayer Corp., The, Cleveland, Ohio.
Ross, J. O., Engineering Corp., New York, N.Y.

RODS—Nickel Alloy
Eastwood Nealley Corp., Belleville, N. J.
International Nickel Co., Inc., New York, N.Y.

RODS—Stainless Steel
Armco Steel Corp., The Middletown, Ohio

RODS—Wire—Non-Ferrous
Eastwood-Nealley Corp., Belleville, N. J.
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

RODS—Wire, Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's John A., Sons Co., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

ROPE—Wire
American Steel & Wire Company, Cleveland, Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Roebling's, John A., Sons Co., Trenton, N. J.
U. S. Steel Export Co., New York, N. Y.
Wickwire-Spencer Steel, Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.

RUBBER AND RUBBER COMPRESSION TESTERS—
Scott Testers, Inc., Providence, R. I.

RUST PROOF COMPOUNDS—
(See Compounds—Rust Preventing)

RUST REMOVING COMPOUNDS—
(See Compounds—Rust Preventing)

SATURATION SYSTEMS—
Industrial Ovens, Inc., Cleveland, Ohio.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machy, Inc. Pawtucket, R. I.

SHEARS—
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

SHEET—Steel
Armco Steel Corp., The Middletown, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's, John A., Sons Co., Trenton, N. J.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

SOAPS—Industrial and Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Bick, Hans C., Inc., Reading, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H. Co., Inc., Homer, N. Y.
Nopco Chemical Co., Harrison N. J.
Potter, Neil C., Newark, N. J.
Procter & Gamble, Cincinnati, Ohio.
Swift & Company, Chicago, Ill.

SOLVENT RESIN SYSTEMS—Experimental
Industrial Ovens, Inc., Cleveland, Ohio.

SPOOLS—Annealing and Wire Drawing
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Company, Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

SPOOLS—Shipping and Shop
Apco Mossberg Co., Attleboro, Mass.
Clark Mfg. Co., J. L., Rockford, Ill.
Howsam Spool Company, Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp.,

SPOOLS—Steel
Apco Mossberg Co., Attleboro, Mass.
Clark Mfg. Co., J. L., Rockford, Ill.
Howsam Spool Company, Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

STAMPINGS—Steel
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Brass and Non-Ferrous
Chase Brass & Copper, The Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.

STRIP—Steel
Armco Steel Corp., The Middletown, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth Sterling Steel & Carbide Co., McKeesport, Pa.
Roebling's, John A., Sons Co., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

SWIFTS—Take-off
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Watson Machine Co., Paterson, N. J.

WHERE TO BUY, Continued

TANK—Compound
Haveg Corp., Newark, Del.
Watson Machine Co., Paterson, N. J.

TANKS—Pickling
Haveg Corp., Newark, Del.
Sauereisen Cements Co., Pittsburgh, Pa.

TANKS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.
National Annealing Box Co., Washington, Penna.

TINSEL—Cords, Decorative
Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, N.Y.

TINSEL—Electric Conductor
Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, N.Y.

TINSEL—Electric Resistance
Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, N.Y.

TINSEL—Lame, Silver and False Gold
Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, N.Y.

TINSEL—Thread, Silver and False Gold
Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, N.Y.

TINSEL—Thread, Decorative
Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, N.Y.

TOOLS—Wire Cutting
Porter, H. K., Inc., Everett, Mass.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

TRAVERSES—For Reels
Entwistle, James L. Co., Pawtucket, R. I.
Hubbard Spool Company, Chicago, Ill.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

TRAVERSE MECHANISMS—
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machy, Inc. Pawtucket. R. I.

TUBE BENDERS AND FORMERS—
O'Neil-Irwin Mfg. Co., Lake City, Minn.
Ruesch, H. J. Machine Co., Newark, N. J.

VALVES AND FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

VARNISHES—For Insulation
General Electric Co., Schenectady, N. Y.
Standard Varnish Wks., Staten Island, N. Y.

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
American Insulating Mach'y Co., Phila., Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.

WELDERS—Spot and Butt
Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago, Ill.
Sciaky Bros., Inc., Chicago, Ill.

WIND-UP AND UNWIND SYSTEMS—Continuous
American Insulating Mach'y. Co., Phila., Pa.
Davis, R. L. Electric Co., Wallingford, Conn.
Entwistle, James L., Co., Pawtucket, R. I.
Industrial Ovens, Inc., Cleveland, Ohio.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machy, Inc. Pawtucket, R. I.

WIRE—Aluminum
Aluminum Co. of America, Pittsburgh, Pa.
Malin & Co., Cleveland, Ohio.

WIRE—Cast
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Cold Heading
Armco Steel Corp., The Middletown, Ohio
American Steel & Wire Co., Cleveland-Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's John A., Sons Co., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Electric
Chase Brass & Copper, The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Malin & Co., Cleveland, Ohio.

WIRE—Enameled for Coils
North American Philips Co., Inc., New York, N.Y.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Armco Steel Corp., The Middletown, Ohio
American Steel & Wire Co., Cleveland-Chicago & New York.
Bethlehem Steel Co., Bethlehem, Pa.
Chase Brass & Copper, The, Waterbury, Conn.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel & Carbide Co., McKeesport, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's, John A., Sons Co., Trenton, N. J.
Tennessee Coal, Iron & R. R. Co., Birmingham, Ala.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., of Colorado Fuel & Iron Corp., Buffalo, N.Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Nickel & Nickel Alloy
Eastwood-Nealley Corp., Belleville, N. J.
International Nickel Co., Inc., New York, N. Y.

WIRE—Music
American Steel & Wire Co., Cleveland, Chicago-New York.
Columbia Steel Co., San Francisco, Calif.
Ecca Machine Corp., New York, N. Y.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Malin & Co., Cleveland, Ohio.
Paramount Wire Co., New York, N. Y.
U. S. Steel Export Co., New York, N. Y.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.

WIRE—Nickel Silver and Phosphor Bronze
Chase Brass & Copper, The, Waterbury, Conn.
Eastwood-Nealley Corp., Belleville, N. J.
Hudson Wire Co., Ossining, N. Y.
Malin & Co., Cleveland, Ohio.

WIRE—Non-Ferrous to Specification for Special Purposes
Chase Brass & Copper, The, Waterbury, Conn.
Eastwood-Nealley Corp., Belleville, N. J.
Hudson Wire Co., Ossining, N. Y.
North American Philips Co., Inc., New York, N.Y.
Paramount Wire Co., New York, N. Y.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRESERVING—Paper and Cotton
Paramount Wire Co., New York, N. Y.

WIRE—Spring
Armco Steel Corp., The Middletown, Ohio
American Steel & Wire Co., Cleveland - Chicago
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Indiana.
Firth-Sterling Steel & Carbide Co., McKeesport, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Keystone Steel & Wire Co., Peoria, Ill.
U. S. Steel Export Co., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Stainless Steel
Armco Steel Corp., The Middletown, Ohio
American Steel & Wire Co., Cleveland-Chicago-New York.
Columbia Steel Co., San Francisco, Calif.
Firth Sterling Steel & Carbide Co., McKeesport, Pa.
Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.
U. S. Steel Export Co., New York, N. Y.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Firth Sterling Steel & Carbide Co., McKeesport, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Keystone Steel & Wire Co., Peoria, Ill.
Paramount Wire Co., New York, N. Y.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Straightening and Cutting—
Pittsburgh Cut Wire Co., Pittsburgh, Pa.

WIRE—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

WIRE CLOTH—Industrial
Roebling's John A., Sons Co., Trenton, N. J.
Wickwire Brothers, Cortland, N. Y.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.

WIRE TESTERS—
Scott Testers, Inc., Providence, R. I.

WIRE, WEAVING—Non-Ferrous
Chase Brass & Copper Co., The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Paramount Wire Co., New York, N. Y.

WRAPPING PAPER—Creped
Augier Corporation, Framingham, Mass.
Crepe-Kraft Co., Newark, N. J.

YARNS & TAPES—
Du Pont de Nemours, E. I., Co., Wilmington, Del.
General Electric Co., Schenectady, N. Y.
Owens Corning Fiberglas Corp., Toledo, Ohio.
Twitchell, E. W., Philadelphia, Pa.
Warren Thread Works, Inc., W., New York, N.Y.

YARN TESTERS—
Scott Testers, Inc., Providence, R. I.

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ESTABLISHED 1845
PATERSON 3, NEW JERSEY, U. S. A.

Wire & Wire Products
July, 1948

ELECTRICAL WIRE AND CABLE AND WIRE ROPE MACHINERY

THREAD AND TAPE SERVING HEADS

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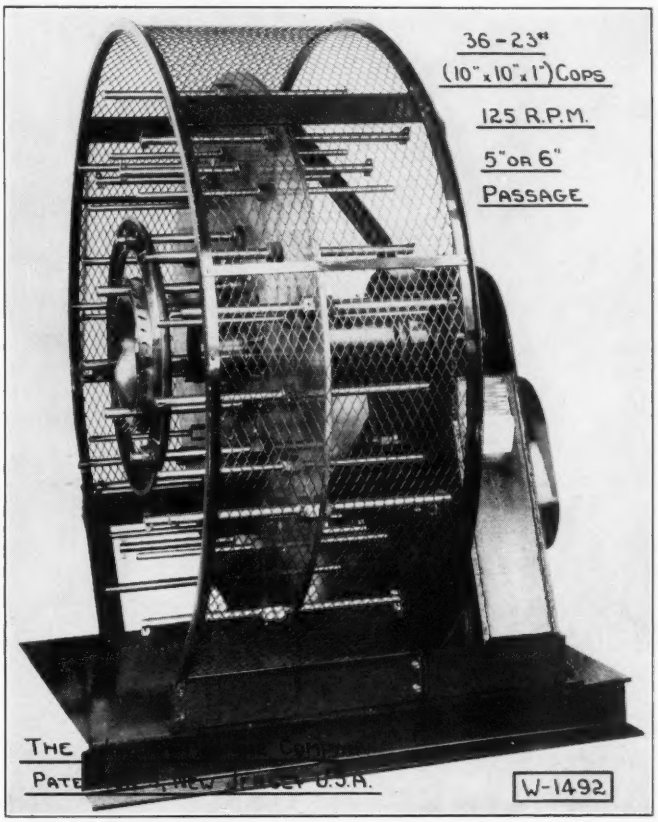
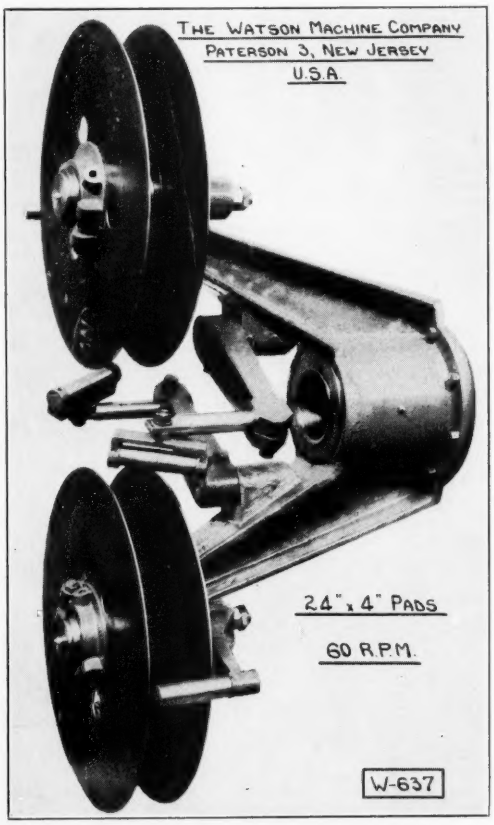


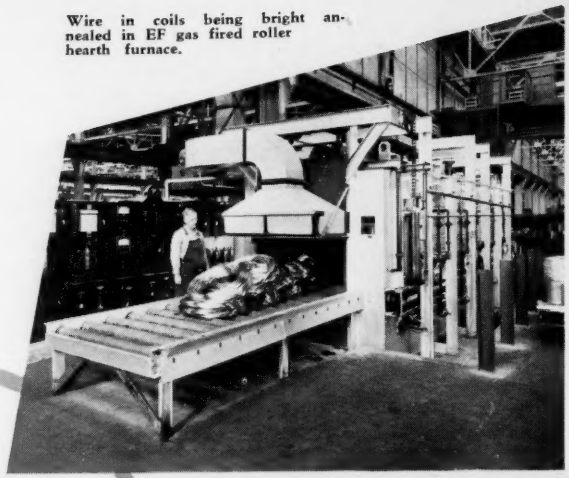
"BURLAP HEAD" (below) IS INTERCHANGEABLE WITH JUTER DISC. GENERALLY PROVIDED WITH PARKWAY CABLE MACHINES BUT ALSO WIDELY USED FOR RUBBER HOSE TAPING.



FOR INFORMATION ON ALL TYPES OF SERVERS, SINGLE OR DOUBLE REVERSED, BINDER HEADS, ETC.

REQUEST OUR NEW MACHINERY BULLETIN No. 022248.

Wire on reels being bright annealed uniformly and continuously in EF gas fired radiant tube bulkhead tray type furnace.



Wire in coils being bright annealed in EF gas fired roller hearth furnace.

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assures users a maximum of long, highly efficient trouble free operation

EF bell type furnace for annealing wire or strip. Has forced circulation to improve heating rate, temperature distribution and uniformity.

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EF engineers conceived and developed the first automatic and continuous heat treating, quench and drawing equipment, that revolutionized all previous furnace practices. They pioneered and perfected the use of endothermic, exothermic and other special atmosphere treatments, which greatly advanced the metallurgical processing of metals, resulting in closer physical tolerances, and permitting the successful use of brazing for joining assemblies of metal parts.

EF developed the first continuous furnace—using low cost atmospheres—for bright annealing steel and non-ferrous strip and wire; and many other devices which are still available only in EF design.

These include the EF radiant tube with heat exchanger which assures extremely high combustion efficiency; the EF cast alloy electric heating elements; EF roller design and mounting that minimizes servicing and maintenance, and other facilities that assure uniform temperatures throughout the furnace, accurate control of heat input within the required limits, reduced maintenance, high hourly outputs, and uniform, low cost, dependable operation.

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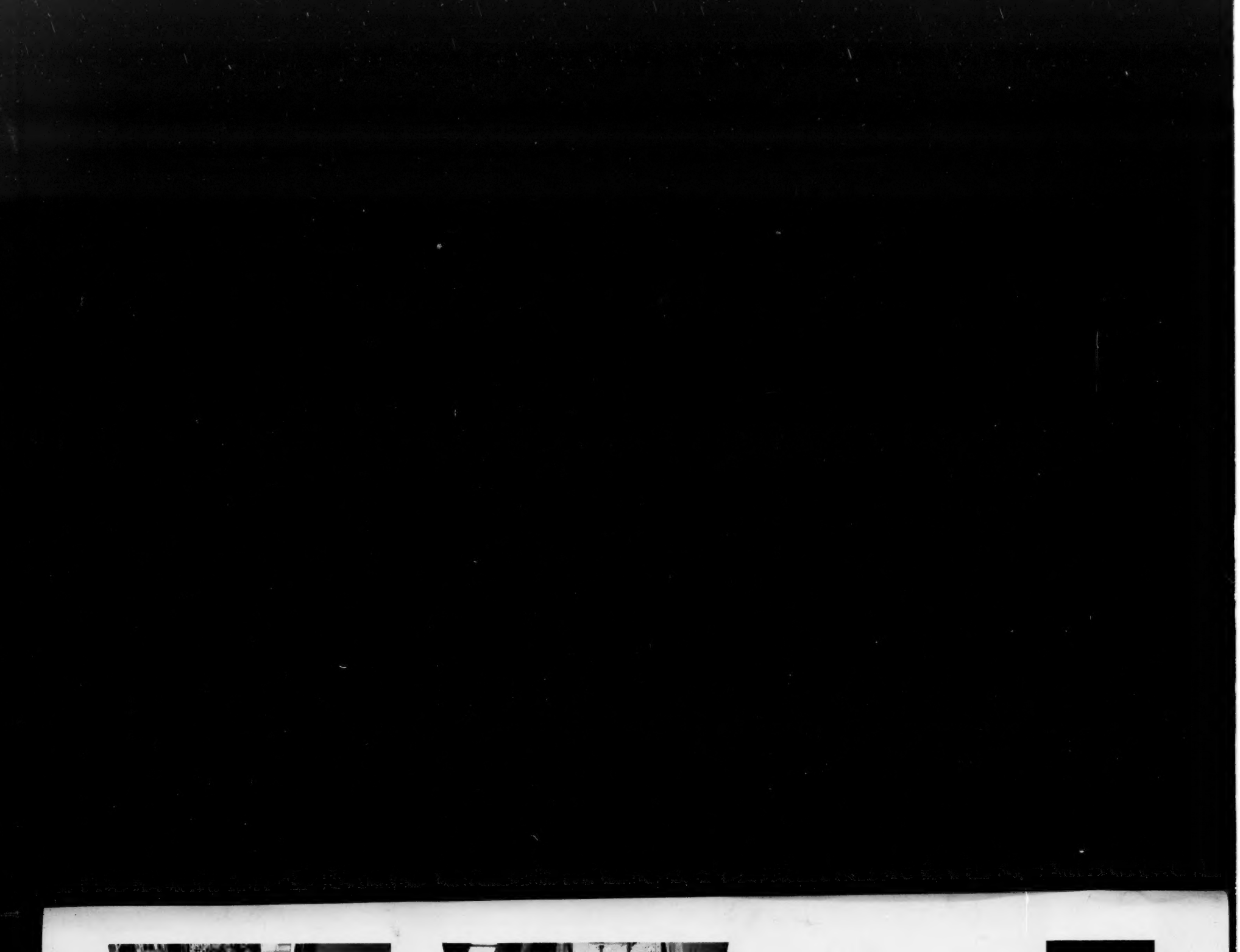
Salem-Ohio